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THE WAR AND THE CHEMICAL INDUSTRY[1]

PHILADELPHIA was the cradle of chemistry in this country. What was possibly the first chemical society in the world was founded here in 1792. A few years later one of its members addressing the society said:

> The only true basis on which the independence of our country can rest is agriculture and manufactures. To the promotion of these nothing tends in a higher degree than chemistry. It is this science which teaches man how to correct the bad qualities of the land he cultivates by a proper application of the various species of manure, and it is by means of a knowledge of this science that he is enabled to pursue the metals through the various forms they put on in the earth, separate them from substances which render them useless, and at length manufacture them into various forms for use and ornament as we see them. If such are the effects of chemistry, how much should the wish for its promotion be excited in the heart of every American! It is to a general diffusion of knowledge of this science, next to the virtue of our countrymen, that we are to look for the firm establishment of our independence. And may your endeavors, gentlemen, in this cause, entitle you to the gratitude of your fellow citizens.

Considering the time when these words were spoken, we must marvel at the vision of the future which must have illumined the mind of the speaker. If in the last clause quoted he had said "ladies and gentlemen" it would have been complete.

But Philadelphia was also the cradle of the chemical industry in this country, and up to the present day occupies a very important part of that field. Some of the pleasantest recollections of my earlier life

[1] Address complimentary to the citizens of Philadelphia given by Dr. Wm. H. Nichols at the Philadelphia Meeting of the American Association for the Advancement of Science.

are associated with those fine men then prominent here, but now mostly passed on, who made this city respected wherever chemical products were concerned, and not an insignificant part of my youthful enthusiasm was imbibed from them.

Therefore, when I was asked to talk to you on the subject of the war and the chemical industry, I accepted with the hope that I might add something to the general knowledge on the subject, and in a modest way pay a portion of an old debt. In the interval which has elapsed, however, the ground has been covered by many men on many occasions, and I find myself in the position of talking to you on a subject as well understood by most of you as it is by myself. There may be certain phases, however, which will repay further thought, and possibly there may be deductions worth considering. I shall therefore ask your indulgence if I ramble somewhat, and talk largely about what we have not done, avoiding dry statistics as far as possible.

Some of us may be old enough to remember our own civil war. Most of us remember the so-called Spanish war. Any knowledge or experience gained from these wars, intimate as the former was, gives no data on which to base any calculation as to the world-wide results of the present devastating struggle. Even our imaginations are unable to satisfy our judgments, which are more or less consciously or unconsciously influenced by our point of view. It is simply impossible to forecast the results industrial, geographical or moral. The world has never seen anything like it before, and, therefore, reasoning from analogy is entirely out of the question. We know this, however, that where such an enormous number of men are withdrawn from ordinary pursuits, many never to return, and such incalculable damage is done to property, the world must feel for many years to come the effects which this impoverishment must produce. We might just as well accustom ourselves to the thought that before us lie years of painful toil and reconstruction, so that prudence, that great virtue of our forebears, may become more and more a part of us, and drive out the vice of extravagance which has become such a prominent characteristic of our people.

Judging from what we read in the papers, we might conclude that the chemical industry in the United States is in an infantile condition, and hardly worthy of serious consideration. Those not acquainted with the subject are ready to admit without argument that almost any European country is far and away ahead of us in volume and ability to produce economically. A glance at the 13th United States census will dispel at least some of these views, and is well worth taking. It includes under the heading "chemicals and allied products," nine principal divisions, and gives the value of the output of each.

1. Paint and varnish	$125,000,000
2. Chemicals (general)	117,000,000
3. Fertilizers	104,000,000
4. Explosives	40,000,000
5. Dyestuffs and extracts	16,000,000
6. Sulphuric, nitric and mixed acids	10,000,000
7. Wood (except rosin and turpentine)	10,000,000
8. Essential oils	2,000,000
9. Bone, carbon and lamp black	2,000,000

The above values were produced by 2,140 establishments, having a capital of $483,000,000, and employing 88,000 persons. The census does not state, however, what is probably the fact, that the United States produces more sulphuric acid by catalysis than any other country in the world, and possibly more than all other countries combined. This fact has a bearing on what will be alluded to later, namely, the possible manufacture of coal-tar dyes and other products, for which fuming sulphuric acid is often an absolute necessity.

The census furthermore shows that the return on capital invested in the chemical and allied industries is not so great as in other branches of manufacturing endeavor. This is due to the high initial cost of plant, frequent alterations and reconstructions made necessary by the advance of knowledge, and I imagine by a somewhat senseless competition which has seemed to affect chemical manufacturers for as long as I can remember.

Owing to the enormous territory covered, the conditions governing the industry are quite different from those existing in other countries. Like all industries the greatest economies can be practised in the largest units, but this fact of extensive territory which is served makes numerous small units necessary. The products usually are bulky and low priced, and railroad freights play an important part in the problem. This fact must be borne in mind constantly when comparing the industry in this country with that in any other.

We Americans are apt to pride ourselves on the progress which we have made along manufacturing lines, and take to ourselves great credit for what has been accomplished. In view of the enormous supply of various raw materials which this country has at its disposal, an analysis of what we have done, I fear, would show that instead of taking undue credit to ourselves we should be very humble because we have not done much better. Of course I realize that this is a comparatively new country, and that it took time to get things into working order. Lines of communication had to be constructed, factories had to be built and rebuilt, and all the necessary impedimenta of industry had to be evolved from a condition which, at the time the Philadelphia chemist quoted in the beginning spoke, consisted of little more than forests, prairies and prospects of mines. If during this period of development a good deal of waste occurred, and a number of abuses crept in, it is not so much to be wondered at. We have, however, arrived at a period when it is borne in upon us from all sides that conservation of natural resources, as well as human energy, is absolutely essential if we are to go forward with anything like the strength and certainty to which our resources entitle us.

Of raw materials for the chemical industry, without going into unnecessary voluminous details, we have an abundance—cheap phosphate rock, salt, copper, sulphur, coal, wood, bauxite, zinc. In addition to raw materials, and among our most valuable assets are our college professors of chemistry, who, I am sure, could, if called upon, render additional priceless service to the lasting benefit of the world and of themselves.

On the other hand, we must import much of our sulphur in the form of pyrites, nearly all of our potash, all of our tin, nickel and nitrate of soda. We have large supplies of nitrogen, available from animals and coal. But the great supply of the future is still in the air. This source of supply, however, has up to the present time proved rather difficult of access. Of course it must be secured, but just how is not altogether clear in spite of the good work already accomplished. This is one of the problems which the chemist, chemical engineer and electrical engineer must solve, however, within a comparatively few years, as the nitrate beds of Chili, while still very large, will some time come to an end.

With the Allies in command of the sea the war has not affected any of these raw materials very greatly, except potash. This salt is widely enough disseminated in various forms in this country, but where of hopeful strength it is inaccessible, and

where accessible it can not be produced without expensive plant construction which would probably be useless as soon as the German supply is once more obtainable. In arriving at this conclusion due note must be made of the German costs and not of the German selling prices. The Stassfurt salts can be produced very cheaply indeed, and the price which they have been able to bring in the markets of the world have yielded an enormous profit. This fact, of course, is a determining one when we talk of producing our own potash.

One of the most important of the chemical industries is the manufacture of fertilizers for the soil. We have in this country enormous deposits of phosphate rock, easily accessible and cheaply mined. This rock has been exported in large quantities to Europe and the Orient and is in sufficient quantity to last a number of years even in the careless way in which it has been used. A complete fertilizer, however, requires potash and, as noted above, we have been in the habit for a number of years of getting our potash from Germany, and there is every reason to expect that we will continue to do so for many years to come. If, as one of the results of the war, while it lasts, enough potash can not be obtained to make the fertilizers to which we have been accustomed, I feel that this will not be an absolutely hopeless misfortune. It is quite possible that the propaganda for the use of potash has been carried too far, and that less could be used on the soil without any great disadvantage. At any rate, we will be quite able to furnish an abundance of fertilizers in this country containing phosphoric acid and nitrogen, and if for a while we have to rely more or less upon the soil to furnish its own potash, I imagine we will not suffer beyond redemption. From some quarters in the south and elsewhere I have heard rumors that a smaller cotton crop would be looked upon as a blessing, and it is quite likely that without government or other assistance the natural laws of supply and demand will produce a smaller crop next year, simply because there may not be enough potash to supply the requirements of a large one.

With here and there an exception, the only effect the war has had upon the chemical industry is the effect which it has had upon those industries which consume its output, and I think this can be taken as a general statement covering all articles. Of course, there are notable exceptions, such as smokeless powder and other products required for war purposes.

Some heavy chemicals, the receipt of raw material for which has been very much curtailed or stopped altogether, have advanced sharply in value, but generally speaking the chemical industry has not profited by advanced prices as a result of the war. Owing to reduced home consumption, the result in some cases has been a great falling off in profit, a condition which I trust will not be of long duration. I am a believer that the manufacturing industries of this country will before very long be on the up grade and all of the chemicals produced, speaking generally, will be needed.

More has been talked and printed lately about a portion of the chemical industry which has not taken very deep root in this country, than about all the rest of the industry put together. I refer to the organic chemicals resulting from products of the distillation of coal tar. Many have wondered why the American chemist has not stepped up and taken the place of the foreign manufacturer in supplying the textile and other industries with colors, evidently not understanding the size and complexity of the question. I think it worth while, there-

fore, to discuss this at some length, as it is probably the most pressing question before the chemical world in this country to-day and I fear the one least likely to receive a favorable reply. A few years ago every coke oven in this country was what is known as a bee-hive oven, and all the by-products of the distillation of coal were lost. It is only in comparatively recent years that by-product furnaces have been constructed and various by-products saved. The ammonia was naturally first utilized and the products of the distillation of tar have been among the last. In fact, a theory existed in the minds of many people that the tar produced by American coal did not possess the necessary constituents to make it useful as a basis for the production of organic chemicals. I have been myself told by one of the large producers in Germany that it was absolutely certain that American coal did not possess the necessary qualities. The object of this information was probably to put out of my mind any latent ambition along forbidden lines, but as it was given by the commercial manager and not by one of the scientific staff, I believed him, but wondered if it were true.

In a lecture delivered to the board of directors of the General Chemical Company on October 23, 1914, the subject and its difficulties were outlined by Dr. B. C. Hesse. Owing to the immensity of the subject only a small part of it was treated. This able lecture has since been published in the *Journal of Industrial Chemistry*, but I can not do better than quote from it freely, as I consider it the best exposition of the case that has come to my attention. He says:

> At the very beginning it should be pointed out that the world's market in coal-tar dyes, as it stands to-day, comprises, in round numbers, 900 distinct and different chemical substances which are made by the aid of 300 products of transformation, themselves not dyes, of 10 products obtained or obtainable from coal-tar by distillation, refrigeration, expression or the like. Therefore, actually and in reality the present coal-tar dye industry comprises no fewer than 1,200 different products and as many or more different processes of manufacture and requires many hundred different sets of apparatus of varying capacity and of different kind for many hundred different operations. A manufacturing problem comprising so many independent and yet interlaced units of manufacture and production has therefore within it many elements of complexity.
>
> World's figures are not available. The fullest, best, most dependable and most recent figures are those dealing with Germany. In the year 1913 the total export value of Germany's coal-tar industry, including dyes and products of chemical transformation or intermediates, amounted to $55,264,522 distributed over 33 countries and shared in by 22 factories; on June 30, 1912, 21 of these factories had a combined capitalization of $36,700,000 and declared and paid dividends of $11,600,000, or 21.74 per cent. of the capitalization, for that year.
>
> Of the 5,369 active corporations in Germany on June 30, 1912, 1,004 or 18.69 per cent. are divided into 19 groups of the chemical and allied industries. Arranged in the order of their income-producing effects these 19 groups are, in part, as follows:

	Per Cent.	No. of Corporations
Coal-tar dyes	21.74	21
Metallurgy	11.78	61
Soaps and candles	11.65	21
Glass	11.61	38
Heavy chemicals	11.51	104
Explosives	11.22	28

> The remainder range between 5 per cent. and 10 per cent., except mining which is at the foot of the list with 0.51 per cent. return.
>
> Therefore, any attempt to take away coal-tar dye business from Germany means attacking the best equipped and the best income producer of Germany's entire chemical and allied industry.

Dr. Hesse estimates as follows on the entire world production:

Germany	$68,222,846
Great Britain	5,982,675
Switzerland	6,452,651
France	5,000,000
United States	3,750,000
	$89,408,172

with Russia, Holland, Austria and Belgium to be added. Allowing $10,000,000 for these, which is clearly very high, it makes the absolute maximum production all over the world substantially $100,000,000.

The development of the coal-tar dye industry called for 8,062 German patents in the years 1876–1912 or 224 per year; corresponding patents have been taken out in other countries, *e. g.*, 2,432 in the United States.

But it is authoritatively said that only 1 in 100 of the German patents is a money-maker, and as a matter of fact, in the case of the 921 dyes in the world markets at the end of 1912, only 485 U. S. patents and 762 German patents were involved or 19.94 per cent. of the total U. S. and 9.46 per cent. of the total German patents. Of these 921 dyes 50 per cent. were never patented in the United States, the U. S. patents on 26 per cent. have now expired, leaving 24 per cent. still covered by existing U. S. patents and many of those expiring in 1915.

Broadly speaking, the entire coal-tar dye industry is a complicated maze and network of interlocking and interlacing products and by-products; these are great in number but, in most cases, small in volume individually. In numerous instances the very existence of the by-products was the sole directing cause for the invention of new dyes and classes of dyes.

The average annual unit gross per year of the 900 coal-tar dyes, exclusive of alizarin and indigo, all over the world outside of Germany has previously been shown to be about $41,000. Add to this fact the interlocked and interlaced dependence of intermediates and finished dyes, further that the German works have long ago fully paid for their plant, their experience and their sales organization and the result is what seems to be a complete answer why Germany controls the world's coal-tar dye market. In fact, the whole industry, taking everything into account, is just about a one-nation business. It is a business made up of a large number of small units and all units essential to success.

Germany has this business established in 33 other countries; it is evident that any country starting in now would be greatly handicapped thereby if it attempted to enter the race for the full distance.

Although Germany has relied upon Great Britain for its crudes, *i. e.*, its benzol, its toluol, its naphthalene and its anthracene up to the middle of the '90's, and perhaps later, yet England has not been able to make any headway, but on the contrary has always lost ground. Many of these non-patented world's dyes are also non-patented in England, yet most of Great Britain's requirements of those materials have always been supplied by Germany.

The answer to the question as to why Great Britain has not succeeded against Germany can not be that Great Britain is not a nation with highly developed chemical industries. A German chemist as well equipped as any other living man to express an opinion and to compare German industries with British industries has said the following:

"To be sure, we know that several of the European countries, *e. g.*, England, are still ahead of us in many branches of the chemical industry, especially in inorganic manufacture. But in no country on earth are those branches of the chemical industry which demand versatility of thought, and particularly a large body of scientifically trained employees, so well developed as with us. Our synthetic dye, synthetic drug, and perfumery industries are foremost throughout the world, and there is probably no country in which the heads of factories are so imbued with the conviction that their employees must needs cast a glance beyond domestic boundaries."

Each one of the large chemical manufacturing countries of Europe, without exception, buys more intermediate products from Germany than it sells to Germany and all of the countries but one, namely, Switzerland, buy more dyestuffs from Germany than they sell to Germany. In other words, and broadly speaking, all the rest of the world, outside of Germany, merely assembles intermediates purchased from Germany, into finished dyes; Germany alone makes all its own intermediates; that is, Germany makes all the dye-parts and the rest of the world assembles these dye-parts into finished dyes. Needless to say, the one who controls the manufacture of dye-parts actually controls the manufacture of dyes.

Where Austria, Belgium, France, Great Britain, Italy, Russia and Switzerland singly and combined have failed, in spite of their large other chemical industries, to take away this business from Germany, the American chemist should not be blamed nor found fault with because he has not succeeded, nor should it be assumed that transplanting of the whole industry can be done at once and is a perfectly easy thing to do, as so many seem to think. The transplanting of that industry

out of Germany is an undertaking properly and fitly to be described as titanic.

Why the other countries have failed is probably due to the fact that they contributed little or nothing to the real upbuilding of the business and to its creation, for the coal-tar dye business is a *created* business; those who aided in its creation were in a position first to reap the benefits—an advantage they have no doubt earned and deserved through the effort they expended and the risks they assumed.

In 1913 Germany had for sale to foreigners $3 worth of these products as against every dollar's worth that it needed at home.

Nine hundred different dyes were on the United States markets of which one hundred were made or assembled in this country from intermediates purchased from Germany. Yet these one hundred do not seem to be enough for American dye-users. How much less than the full nine hundred will satisfy American users is known to them and to the importers; the latter can not be expected to divulge that information; if the former want substantial help from American chemical makers *they* must divulge it, no other way of ascertaining being available.

In 1909 the United States produced $3,462,436 worth of artificial dyes which are probably anilin dyes in the strict sense. Compared with Switzerland's $3,200,000 production, *i. e.*, "assembly" in 1896 this is an achievement of which Americans need not be ashamed. The wonder is not that we have not done more but that in the face of the well-organized manufacturing plants of Germany and of Germany's very much superior facilities for foreign trade, both banking and carrying, that we have done as much as we have. Blame should not be parcelled out for what American chemists have not done, but credit, which has been so far withheld, should be given for what has been done in spite of obstacles abroad and obstacles at home. The users of dyestuffs have invariably opposed any tariff enactment that would substantially encourage a domestic production of coal-tar dyes. That so many are produced in this country as are being produced is due to no cooperation of dyestuffs users but was accomplished in spite of their obstruction and if to-day the users are in serious difficulty through a lack of dye-stuffs they have their own shortsightedness to blame and can not, by any argumentation whatever, shift the blame to American chemists. With proper help and encouragement the American chemist will be able to increase the domestic production of coal-tar dyes and to inaugurate the making of intermediates; in the course of time this country may then ultimately look forward to a substantial share of the world's coal-tar dye business.

Hardly any of the valuable or useful intermediates ever were patented. A considerable number of non-German chemists have invented and patented finished dyes made from non-patented intermediates. These inventors had perfect freedom to make the needful intermediates and an *exclusive* right to make, sell and use their new dyes therefrom, yet they bought their intermediates from Germany rather than make them themselves. The patent situation is therefore, really, that Germany excelled the rest of the world in making patentable combinations from non-patented and non-patentable intermediates and further in making those non-patented and non-patentable intermediates in open competition with the rest of the world. So, from one point of view, it appears that the rest of the world, inclusive of the United States, lay back, let the Germans do all the hard work and when the rest of the world finally woke up to the value of what the Germans had accomplished they became very busy making excuses and explaining instead of making a determined, directed, united and effective attempt to recover the ground so lost. That such a recovery will require the hardest kind of work on the part of all, users, capitalists, consumers and makers alike, is self-evident and obvious and the question is: do we want to pay the price? It can be done, if the price be paid.

At the conclusion of Dr. Hesse's lecture the directors were called upon for remarks. One well qualified arose and simply quoted from Mrs. Stowe's "Old Town Folks":

> One of the characters, Sam Lawson, had gone to "meetin' house" to hear the new preacher, and returning shortly afterwards to the kitchen, where the "women folks" were preparing the meal, they inquired of him why he happened to come so soon —"surely meetin' couldn't be out."
>
> He replied: "No, meetin' isn't out, but the preacher said how by a state of natur' we were all down in a deep well, and the sides of the well were glar ice. There warn't one in ten, warn't one in one hundred, warn't one in a thousan' never get out, and yet it war the partickler duty of every one of us to get out. At that pint in the discourse, I rose and went out, thinkin' any one was welcome to my chance."

From the foregoing it will appear as if the opportunity to produce colors and other articles and products in a large way in this country, while open, are not likely to be availed of to any great extent during the existence of the present war, unless the war should last much longer than even the most pessimistic fear.

I might say, however, in this connection that I remember distinctly being told by one of the best authorities on the subject that it was absolutely impossible to manufacture Portland cement in this country and it might just as well be put aside as one of the things for which this country was not adapted. I have also heard exactly the same statement regarding soda ash and caustic soda, and yet these articles somehow or other have become rather important articles of our manufacture and for a long time we have not been obliged to call loudly for outside help.

In spite of the difficulties, however, some feeble steps have been taken here, partly, I confess, out of curiosity to learn if it were really true that our coal lacked the self respect to hold all the treasures it should possess; when, strange to relate. out came aniline oil of the best quality. What happened then is worthy of note, as it shows at least one state of affairs which it is necessary to correct if we are going to escape from the dilemma which discouraged Sam Lawson. As soon as American aniline oil was offered for sale, down went the price below cost. A tariff of 10 per cent. put upon it by Congress as a compromise between judgment and party, was immediately absorbed by the foreign makers, and the price here became lower still. You see, on the other side of the Atlantic they believe in cooperation. Here our legislators think we believe in destructive competition, and have made cooperation one of the seven deadly sins. Nothing but demonstration by the ballot box will prove the contrary. A man with his ear to the ground does not always hear the "music of the spheres." The low price of aniline oil had no relation to its cost. It was simply dumped, by agreement, to discourage the American infant. And it did.

Many devices have been suggested to encourage the coal-tar dye industry in this country, such as a high protective tariff and changes in the patent law.

The former does not seem likely to be evolved, although a good deal can be said on the side that a high tariff in these articles would either result in the establishment of the industry or else produce a considerable revenue, either end most desirable to attain. The latter is such a complex subject that it is not so clear that good results would ensue on changing the patent laws. While it is important to establish a coal-tar dye industry as far as is practicable, we must not be selfish enough to forget that there are other important industries already established, and the American people must learn more and more to consider the rights and needs of the individual in their relation to the rights and needs of all.

Another obstacle, besides the patent laws and the absence of tariff protection, to the establishment in this country of any new industry strongly intrenched abroad, is to be found in the inadequacy of the anti-trust laws to protect American industry against systematic dumping of goods from abroad at prices substantially less than foreign prices with intent to injure or destroy the local industry.

Much has been done by the present Congress in the creation of a trade commission and in the statutory condemnation of certain specific practises to render those laws more efficient; but, taken as a whole, the efficiency of those laws, so complete for

domestic commerce, is quite unsatisfactory when applied to imports from abroad, and that despite the very real help to be expected from the new trade commission.

The trouble lies partly in the inherent difficulty of the subject and partly in the inadequacy or ambiguity of previous legislation. First of all, our anti-trust laws can have no extra-territorial force. Cartels and trusts that would be invalid here are lawful abroad, and in so far as these operate on their own soil, even to our detriment, the individuals concerned can with difficulty be reached so long as the acts done are lawful in the country where they are done. But these unfair practises must express themselves in imports into this country, and this implies the existence of importers or agents who must either be, or occasionally come, within the jurisdiction of our laws.

And so we find in 1894 our Congress partially legislated on this very subject, and by the anti-trust sections of the Wilson tariff law (secs. 73–77) visited upon importers who should combine in importing to restrain trade in this country all the pains and penalties of the Sherman law of 1890, namely, fines, imprisonment, forfeiture of goods in transit, triple damages, injunction and dissolution.

But this Wilson bill, which may well be deemed to be the exclusive expression of congressional purpose on this subject of imports, is confined to restraint of trade by two or more—and it does not, like the Sherman law, prohibit monopolizing, nor acts done by one person or corporation alone, nor does it prohibit unfair methods as such.

Now the unfair methods here complained of are precisely those which tend to monopoly by the destruction of competitors, and they can as well be employed by a single powerful concern as by a combination.

Viewed merely as "unfair methods," it is probable that they would not have been held by the courts to have fallen under the Sherman law so long ago as 1894; but would have been classed among those acts which the Supreme Court has lately characterized as "no more than ordinary acts of competition or the small dishonesties of trade."

But in the last few years ideas on this subject have undergone a complete change, and many methods formerly thought legitimate have passed under the ban of the law. Railway rebates are a notable example of this; and now with the legislation of this year we find legislative authority for the condemnation of unfair methods of competition generally, and notably discrimination in prices with intent to injure.

Admirable as are these provisions, there is nothing in the new statutes which extends their scope by way of amendment to the Wilson bill and to imports—and there is much to indicate the legislative intent to confine those provisions to domestic commerce alone. The word "commerce" both in the unfair methods clause (sec. 5, commission bill) and in the price discrimination clause (sec. 2, Clayton bill) is defined as commerce among the states or between this country and a foreign country, and this definition excludes the idea of its including also commerce within a foreign country.

The practises that we complain of involve commerce not in the restricted sense as defined, but a commerce that includes foreign countries as well as our own. But if these practises of foreigners and importers are nevertheless to be deemed unfair methods within the commission bill (sec. 5), the only remedy for them is an order of the trade commission to desist. They are not expressly prohibited by the act itself, nor made punishable in any way. If, however,

these practises are to be deemed price discriminations within the Clayton bill (sec. 2), which seems impossible, then the only remedy besides an order to desist is a right to sue for triple damages. The difficulty in estimating any damages at all is obvious enough in any case; especially so in the case of the destruction of a small *new* industry, and still more so in the case of an embryo industry that has never raised its head.

Even if Sec. 2 of the Clayton bill apply, we must assume that it creates a new offence not included in either the Sherman or the Wilson bills; hence that there would be no authority of law for any remedy except those alluded to as given in the act creating the offence, especially so inasmuch as the Wilson law stands out unrepealed as the sole legislative expression on the subject of imports and is silent and unamended upon the subject of price discrimination.

If this conclusion be correct (and it is almost as bad if the law be in doubt) there exists a situation where the equal protection of the laws is not extended to the importer and the domestic manufacturer alike. On the contrary, a practical license is given to the importer to do that which the citizen is forbidden to do.

The foreign manufacturer or importer seldom has any inducement to act in restraint of trade as we commonly understand it, or to monopolize competing plants in this country; quite the reverse. His object is to build his monopoly by destroying a domestic industry, and one of his most potent weapons in doing this if he be well enough intrenched is to drop prices in this country below the prices which yield him profits abroad for a long enough period to drive out American competitors; when, having the market to himself, he may raise them again.

The penalties to be invoked against the foreign manufacturer and importer as deterrents are utterly inadequate to deter them from trying it on as before. The most that they can suffer from their practises is, as we have seen, a commission's order to desist, and perhaps in some cases a suit, difficult to prove, for triple damages.

What is needed is that these people should have before their eyes the same deterrents of fine, imprisonment, forfeiture of goods, triple damages, possible injunction and dissolution, as have rendered American business men careful neither to restrain trade nor monopolize nor indulge in unfair practises. The practises here condemned in reality amount to much more than mere unfair methods of competition; they verge on an illegal attempt at monopolizing. It is of the essence of monopolizing to exclude. The legislation of 1914 does not subject unfair methods in general to the criminal features of the anti-trust laws, and this is doubtless wise. But this particular offence is in its nature monopolistic and criminal, and it is the most effective form by which the foreigner can evade our anti-trust laws and illegally injure or destroy American industry. What is needed is an amendment of the anti-trust sections of the Wilson tariff act carrying into it the prohibitions against monopolizing of the Sherman act, even when practised by one person alone, and expressly defining the practise here condemned as an act of monopolizing. The pains and penalties of the Sherman and Wilson acts would then follow on these practises as a matter of course.

At the present time, when there can be no longer any thought of procuring additional protection of new industries through the tariff, it will be rash to hope that American capital and enterprise should further

embark in any of those industries, new or unknown here, which are firmly intrenched abroad, and where, as soon as the war is over, the foreigner can return to the work of attack and destruction by the methods above mentioned.

This plan, which aims to place Americans and foreigners on the same footing here could, it seems to me, be easily and quickly enacted by the present Congress. It would put American manufacturers, including American chemists, in a position to act without having all the chances against them. Are they not entitled to at least this much?

I do not believe in hothouse development of industries for which we are not adapted; but save us from the cold-storage conditions resulting from perfect organization being arrayed against us so that our real opportunities which we are in every way qualified to enjoy are frozen to death. The little aniline-oil experiment alluded to above has come to life again, and in its small way has proved during these war times to be a godsend to our manufacturers. It is gratifying to note that it is even growing in a manner which it is hoped will be permanent. It seems too bad that it should require a dreadful war to make such a little start possible; it should have been accomplished as soon as our by-product coke ovens and fuming sulphuric acid production made it possible.

To sum up, the effects of the war on the chemical industry already established in this country are measured in general by their effects on the industries consuming chemical products. It has, however, been brought very close to us that certain industries not thoroughly established here but highly organized abroad are of tremendous importance to us. We have seen that this branch of chemical industry has been the result of marvelous ingenuity, patience, research and cooperation during the more than half century since Perkin produced the first coal-tar dye in England. One of the lessons to us which it seems to me lies near the surface, and probably one of the most important lessons this people must thoroughly learn, is that of cooperation, which has had more to do with the making of the great coal-tar chemical industry than any other one influence. We as a nation have passed our childhood and youth; we have made gigantic progress at tremendous cost of materials and possibly of moral fiber; we have come to the parting of the ways. If we continue too long as we have been going we will deserve disaster if we do not actually experience it. We know on the highest authority that "a house divided against itself must fall." The laws of the resultant of forces familiar to us all show us what would happen if we all pulled in different directions. I feel strongly that our future success as a nation lies in universal cooperation—the government and its departments with the manufacturer, the manufacturer with the workman, and all together for the country and for the world; and this cooperation must not be based solely on self-interest, but more particularly on those moral qualities which lie at the foundation of universal brotherhood. It must not be the survival of the fittest, but the survival of all, and the very best that is in them brought out of all. When we have learned and adopted this lesson of cooperation for the good of all, we have started on the road to a national greatness, both material and moral, which I modestly feel that the possessions of this people qualify it richly to enjoy.

WM. H. NICHOLS

NEW YORK, N. Y.

THE RELIEF OF OUR PACIFIC COAST[1]

Ever since the landing of the Pilgrims on Plymouth Rock and the founding of Jamestown, if not even in the Garden of Eden, "Westward Ho" has been the cry, and the inspiration of this call of the wild is well portrayed by Leutze in his famous painting at the national capitol.

"Westward the Star of Empire takes its way" is no less true to-day than two centuries ago, but from a more commercial point of view.

The near sea level transcontinental water route of the Panama Canal is in strong contrast with the bold relief of the immigrant route of the early days in wagons across the Great Plains and Rocky mountains, with the privations of the Great Basin to the ranges of the Pacific coast with luxuriant wealth of forest and field, affording the framework for the Golden Gate where the Panama-Pacific Exposition is about to celebrate the opening of the great canal.

Many a traveler will find his way from the Atlantic coast to California on that occasion, and to prepare him for the strong contrast between the surface features of the two ocean borders I have selected as my theme on this occasion "The Relief of Our Pacific Coast." It will indeed be a great relief to the generous heart of the Pacific coast to welcome a large number of visitors to the Panama-Pacific Exposition, but that is not the relief to which I refer. It is to the form of the land surface, its ups and downs with reference to the sea level along our Pacific coast, that your attention is invited. It is the subject which in one form or another has held my attention as a field of investigation in connection with the United States Geological Survey for many years. Do not be dismayed at this length of service as affording a suggestion of the duration of this discourse. But quite the contrary, the proportion should be inverse, for it seems quite probable that my eminent predecessor, Professor Lesley, was right when he declared that geologists talk too much, and I shall heed his admonition.

The backbone of the North American continent is in the Rocky Mountain system relatively near the Pacific coast. The great valley of the Mississippi lies to the east with the Appalachians and the coastal plain of the Atlantic States beyond. A 200-mile wide belt on the Atlantic coast, at least from Virginia southward, is a coastal plain and piedmont region without mountains or even big hills, but on the Pacific coast the 200-mile belt is mountainous in the extreme from Canada to Mexico.

The mountain belt of the Pacific coast is but a member of that merged group of mountain systems, the Cordilleran, that runs through the western United States and Mexico and forms the continental bond of Panama, now so happily pierced for the commerce of the world and so fittingly and attractively celebrated in the Panama-Pacific Exposition.

Indeed, it is believed that the mountain belt of our Pacific coast is no small part of the attraction to the exposition. It constitutes not only the framework of the Golden Gate, the scene of the great event, but in itself embraces some of the finest scenic features of the world among which are four national parks, the Yosemite, General Grant, Crater lake, and Mount Rainier, besides three national monuments, the Pinnacles and Cinder Cone in California, the caves of Oregon, and Mount Olympus in Washington, all districts of

[1] Address of the Vice-president and Chairman of Section of Geology and Geography, American Association for the Advancement of Science, Philadelphia meeting, December, 1914. Published with the permission of the Director of the U. S. Geological Survey.

profound geologic and geographic interest and each so distinctive as to be especially attractive.

The relief of a country may be expressed in terms of water power, and considering the rainfall the water power is proportional to the relief. From this point of view the Pacific coast relief is greatly in excess of an equal area of the Atlantic coast.

The area of the direct drainage into the ocean from the Atlantic States is approximately 284,000 square miles,[2] while that into the Pacific, not counting the Colorado River, is about one fourth greater than that of our Atlantic coast, and yet the energy represented by the Pacific drainage is more than seven times that of the Atlantic coast. By far the greater portion is undeveloped and gives some idea of the latent possibilities of the empire of our west. Attention should be called to the fact, however, that much of the Pacific coast power is in the Columbia river, of which the greater part lies east of the mountain belt, but, even excluding that portion of the Columbia, the enormous power of the mountain belt greatly exceeds that of an equal area along our Atlantic coast.

With this may be coupled also that of the production of precious metals, which are vein deposits formed as an adjunct of stresses that express themselves in relief. The production of precious metals in the mountain belt of the Pacific coast in recent years has been hundreds of times that of the Atlantic States.

The mountain-building period on the Pacific coast bordering the larger ocean may have been longer and more intense than that on the Atlantic, resulting in greater and perhaps later segregation, so that erosion has not removed the mountains, as has been the case upon the Atlantic side.

That this is not simply a matter of time, but of actual deformation and uplift, may be inferred from the enormous deposits of limestone and coal to the east, which indicate not only a region of low relief but low relief of wide extent. Strengthening the contrast in the relief of the coasts but balances the values of the mineral deposits.

PACIFIC COAST MOUNTAIN BELT

The continental feature bordering the Pacific coast of the United States is a mountainous belt of surpassing grandeur. Lying between the Great Basin platform of the interior on the east and the Pacific ocean on the west, it is the crushed and upheaved edge of the continent along the line of counter stress between the land and sea. The great upfolds of the earth's surface in that region are so young as to preserve much of the prominent form and mass resulting from the deformation.

It is remarkable for its lineal continuity, with a width ranging from 100 to 200 miles throughout a length of 2,500 miles. Some of it indeed at both the northern and southern ends is below sea level, but other portions, especially in California, Oregon and Washington, bear the highest peaks in the United States south of Alaska.

The general form of the belt is slightly sigmoid with a broad coastal curve to the west in northern California and to the east at the international boundary (49th par.), resulting from large structural features which will appear in an analysis of the members of the belt.

The general features of the belt are two lines or ranges of mountain elevations with a great valley between. For the most part the two lines of mountains appear to be parallel with each other and the coast; the Sierra Nevada and the Cascade ranges on

[2] Water Resources Paper No. 234, pp. 52–57.

the east and the coast ranges, including the Klamath mountains of California and Oregon and the Olympic mountains of Washington on the west from near the Mexican line to British Columbia. They are separated by a depression, a great valley more or less continuous from the Gulf of California and Salton Sea on the south through the Great Valley of California, the Willamette Valley of Oregon and Puget Sound to Georgian strait on the north, which it enters and follows with less definition along the coast of British Columbia to Alaska, a total distance of about 2,500 miles.

In the United States there are only three rivers, the Columbia, the Klamath and the Sacramento (including the Pit), which cut across the entire mountain belt from the interior platform to the sea, although three others, the Chehalis, Umpqua and Rogue rivers, rise on the west slope of the Cascade range and break through the coast range.

The mountain ranges which now constitute the topographic limits of the Great Valley of the Pacific coast are composed of parts that differ widely in origin, age and composition.

THE SIERRA NEVADA

The Sierra Nevada is a massive mountain block, 350 miles long and 80 miles wide, with a long gentle slope west to the Great Valley, and to the east has a short steep slope, due to faulting, that separates the rocks of the Sierra from those of the Great Basin.

The Sierra Nevada is composed of sedimentary and igneous rocks of various ages, from Silurian to Jurassic, which have been closely folded and intruded by batholithic masses of granitic rocks. The folding and intrusion have greatly altered the rocks and developed in them numerous metalliferous veins, chiefly of auriferous quartz. During a long period of erosion which washed away the mountains and reduced the country to low relief the veins gave rise to auriferous gravels, and some of the earlier of these gravels in the northern portion of the range are covered by flows of Tertiary lavas.

The southern and central portion of the range where granodiorite prevails is one great topographic block bounded on the east by a fault zone, which curving to the west around the southern end, meets the San Andreas fault of recent earthquake fame and brings the Sierra Nevada and the Coast range together. In the northern portion of the range along the eastern side of the great block, adjoining the Great Basin and suggesting its structure, there are two smaller fault blocks, one of which locally has sunk for Lake Tahoe, while the other forms the bold eastern escarpment of the range.

The Tertiary lavas of the Sierra Nevada are continuous to the northward with the great pile of volcanics in the Cascade range, beneath which the older terranes of the Sierra Nevada disappear with a strike of approximately N. 50° W. toward the Klamath mountains, about 60 miles away. Some minor faults appear in the lavas of the Lassen Peak region but major faults like those which characterize the Sierra Nevada have not yet been recognized in the Cascade range.

The faulting which limits the Sierra Nevada on the east, as emphasized recently by Ransome, has been of long duration and is still in progress, as evidenced by the many small earthquakes at points along its course. The Owens Valley earthquake of 1872 is the most notable example resulting from a fault of 10 feet.

The earthquake was widely felt, but there are many that are not felt at all under

ordinary circumstances, and yet may be clearly detected and their intensity and duration measured by a seismograph. Every earthquake indicates a change in the relative position of the rocks, however small, either horizontal or vertical or both, and consequently in the relief of the country. It may truly be said that the mountains are growing. In no other part of the United States is there as great seismic activity as along our Pacific coast, a fact which means that the mountains are not only growing, but growing faster than elsewhere in the United States. Some are growing less, others greater, and there is need, as pointed out by Lawson, of establishing bench marks on opposite sides along the faults, so that the amount and character of the change may be measured.

The transformation of the Sierra Nevada from a region of low relief to one of high relief so increased the river grades of its western slope that they have carved out deep canyons which now form the principal relief feature in the scenic attractions of the range. The Yosemite Valley is the finest example, although rivaled by that of Kern River, and is one of our most impressive and instructive national parks. This is especially the case since nature has made some of the finest trees in the region big in proportion, as if to correspond to the size of the canyon.

KLAMATH MOUNTAINS

The Klamath Mountains are an irregular half crescentic group of peaks and ridges along the coast in northwest California and southwest Oregon. The general shape is that of a saddler's knife, with the curved side to the west and the handle to the east, a little south of the center. Their greatest extent north and south is about 225 miles, with 75 to 115 miles in width. The crescentic border follows the coast for about 90 miles north from the mouth of Klamath River in California to near Rogue River in Oregon. To the northwest of the Klamath Mountains is the coast range of Oregon. To the southwest is the coast range of California, both overlapping the western curve of the Klamath Mountains along the coast. On the east lies the Rogue River Valley, Shasta Valley and Sacramento Valley bordered by the great lava field of the Cascade range.

The Klamath Mountains are composed chiefly of Carboniferous and Devonian sediments, with a large proportion of contemporaneous lava flows of rather basic types. Besides these there are large bodies of mica and hornblende schists of pre-Paleozoic age, as well as sediments and effusives belonging to the Jurassic and Triassic.

These rocks are folded, faulted and intruded by batholithic masses composed of granodiorite, gabbro and peridotitic rocks centering in a general core with aligned terminals that curve to the northeast in Oregon and southeast in California. The later sedimentary rocks of the Klamath Mountains, the Jurassic and Triassic, are richly fossiliferous in the Redding quadrangle, where they are associated with equally fossiliferous Carboniferous and Devonian strata that form the hills lying east of the Sacramento River and the railroad between Redding and Mt. Shasta. In the southern part of this exposure the Mesozoic rocks strike S. 50° E. in line with rocks of essentially the same age and position 75 miles away in the northern portion of the Sierra Nevada. To the northward in the Redding quadrangle we see these Mesozoic rocks curve to the right and strike to the northeast in the general direction of the Blue Mountains of Oregon. Now this change in the strike is not limited to the eastern portion of the Klamath Mountains

in the Redding quadrangle, but, more or less distinctly marked, it extends throughout the great stretch of the Paleozoic rocks of the whole group in both California and Oregon. Furthermore, the same curved trend is suggested by the form of the intruded masses. The mass of granodiorite between Lewiston and Igo extends southeast and widens directly toward the Sierra Nevada, where similar rocks are abundant.

While the composition and the plication of the rocks of the Klamath Mountains tend to show close relationship to the Sierra Nevada, it is only partial, and in reality the two are distinct, being separated in the first place by a wide depression probably due, as long ago pointed out by Whitney, to a fault across the trend of the range, and in the second place characterized by a series of overthrust faults quite unlike those which obtain in the Sierra Nevada.

Although the detailed structure of the Klamath Mountains has not been worked out, some of the major structures have been apprehended by Hershey and others sufficiently for consideration in this comparison of the several ranges of the Pacific coast chain.

The southwest limit of the Klamath Mountains against the coast range of California is marked by a profound thrust fault on which the highly crystalline schists of South Fork Mountain appear to have been thrust to the southwest up over the Cretaceous and Jurassic rocks toward the coast. The fault runs northwest and southeast and the hard schists give rise to a prominent long even-crested mountain ridge, one of the most conspicuous members of the Klamath Mountain group.

In Oregon a similar fault occurs through the Kerby region of Josephine County, where Devonian rocks are in effect thrust northwest toward the ocean up over those of Jurassic age. The fault runs northeast and southwest and erosion has developed prominent mountains facing the valley that lies to the northwest.

The Kerby fault if continued southwest in the same strike would intersect the South Fork Mountain fault, but, according to Hershey, before it reaches the South Fork Mountain fault it curves to the south and finally southeast so as to parallel the South Fork Mountain fault.

Farther east there is another fault belt which at the south end in California trends southeast, while at the northern end in Oregon its course is to the northeast. Like the other, it appears to be a thrust fault. Hershey has estimated the overthrust locally in one of the Klamath Mountain faults as much as a mile.

The curved thrust faults traversing the Klamath Mountains are in strong contrast with the normal faults of the Sierra Nevada. The Klamath Mountain thrust is to the westward. The downthrow of the normal faults in the Sierra Nevada is to the eastward. Thrust faulting occurs also locally in the Sierra Nevada, but at Taylorsville the thrust is to the eastward.

The Klamath Mountains are insular in character. Composed largely of Paleozoic rocks and surrounded by rocks of later age, they formed a buttress in the development of the coast ranges of California and Oregon. From the Sierra Nevada they are separated by a depression in the older rocks that extends northward beneath the Cascade range.

During a portion of the Cretaceous the Klamath Mountains were above sea level, but the gradual subsidence of the land almost or quite completely immersed them at the close of the Chico epoch, as shown by the rather widespread occurrence of fossiliferous fragments of sandstone from the Chico formation in the auriferous gravels of that region. During the early Ter-

tiary the region was a lowland of gentle relief cut down like the Sierra Nevada to a peneplain, but later it was raised as perhaps the great valley sank, and became a prominent mountain group.

THE COAST RANGE OF CALIFORNIA

The coast range of California lacks the wealth of precious metals found in the Sierra Nevada, and for that reason until recently it has not received so much attention from geologists. But the discovery of oil and its development has greatly stimulated research in that field. Only a few districts have been surveyed in detail and published, but much general reconnaissance has been done. What we know of the composition, structure and history of the range has been admirably summarized by A. C. Lawson and Ralph Arnold. Their summaries have recently been discussed in a most helpful critical way by Ransome, who is himself familiar with portions of the region.

The coast range of California, according to Lawson, extends from the Mexican boundary to near the mouth of Klamath River, with a length of about 720 miles, a width ranging from 40 to 60 miles, and a general trend of N. 30° W.

At the northern end Lawson includes the South Fork Mountain in the coast range, but it seems to me that the great fault on the western slope of South Fork Mountain is the delimiting feature and keeps the South Fork Mountain and Yallo Bally in the Klamath group.

The coast range is regarded by some, and Ransome among them, as ending on the south at the headwaters of Santa Maria River where the Tehachapi range joins the southern terminus of the coast range to the Sierra Nevada.

South of the Santa Maria River is a group of ridges including the San Rafael, Santa Barbara, Santa Ynez, San Gabriel, San Bernardino and other ranges, which, although not strictly parallel, have a general trend nearly east and west. These ranges embrace the Los Angeles country and have been most appropriately referred to by Ransome as the Sierra de Los Angeles.

The coast range throughout is composed of a succession of parallel ridges which, south from San Francisco to Santa Maria River, trend about N. 43° W., while in the northern portion of the range the trend is N. 26° W., giving an average course of N. 30° W. for this portion of the range. Everywhere the course of the ridges is more or less oblique to the coast line, which is made up of a series of zigzags that Lawson regards as probably due to faulting parallel and transverse to the ridges, thus cutting them off on the shore and affording excellent exposures of the composition and structure of the range.

The coast range of California is composed chiefly of Mesozoic and Tertiary rocks, with some that are older, as well as a considerable portion that belong to the Pleistocene. The oldest rocks are marble, quartzite, mica and hornblende schists like those of the Klamath Mountains and Sierra Nevada. They appear mainly as inclusions in the granitic rocks which form the concealed basement of the coast range and upon which was deposited unconformably the Franciscan formation, a complex succession composed in the main of strongly indurated sandstone with subordinate quantities of shale and conglomerate, a considerable part of radiolarian chert and foraminiferal limestone. In the upper part of the formation are interbedded lavas, and the whole is intruded by peridotite and basalt. A thick series (29,000 feet) of shales, sandstones and conglomerate of Cretaceous age follow unconformably on the crushed Franciscan and are succeeded by an extensive

succession of shales, sandstones and conglomerates of Tertiary and Quaternary age.

In composition the coast range is in strong contrast with the Sierra Nevada, being much the younger. There are great differences in structure also. The rocks of the coast range are folded, as Lawson points out, in rather sharp synclines and anticlines, some of which are overturned, as in the Monte Diablo region, toward the ocean and thrust faulted, but they are never so closely appressed as to indicate general and important deformation of the internal structure of the rocks affected. There has been no development of slaty cleavage or schistosity. In general, the axes of the folds are northwest-southeast, and although the minor folds may be more or less divergent, the major folds are parallel and extend for many miles. The coincidence of many of the larger valleys with a synclinal axis is very marked.

The coast range throughout is a faulted range and the faulting has had even more to do with the form of the relief than the folding. Many of the valleys are fault valleys with unsymmetrical slopes, the fault lying near the steeper slope. The faults, too, are especially interesting because of the earthquakes they produce. Faulting is still in progress, and each slip or movement along the fault plane results in a shock. The great earthquake of 1906 resulted from a slip along the San Andreas rift which has been traced for 600 miles. The movement was greatest in the neighborhood of San Francisco and chiefly horizontal instead of vertical, as is perhaps generally the case. Hundreds of faults slip and slight shocks occur in California every year, and perhaps hundreds more too gentle to attract attention.

The coast range as a whole may well be outlined by faulting. The steep bluff of the coast beneath the shallow and the deep sea is probably due to faulting, and the eastern side of the range in Tehama and Shasta Counties has a series of large sandstone dikes that evidently resulted from an earthquake, possibly in Tertiary time. Unlike the Sierra Nevada, which is mainly one great block tilted so that the streams consequent upon the tilting flow directly transverse to the range, the coast range is composed of many blocks with the main divide along the eastern edge, but the streams, instead of being wholly consequent, taking the shortest route directly to the ocean, are subsequent and follow the lines of easiest erosion along faults and folds to the sea.

According to Ransome, referring to the work of many others, the structure of the Sierra de Los Angeles appears to show a transition from a combination of folding and faulting such as is characteristic of the coast ranges to tilted block mountains, exemplified by the San Bernardino range, such as are characteristic of the Great Basin.

Much yet remains to be done before a comprehensive statement can be formulated concerning the structure of the coast ranges as a whole, but with the large corps of workers from the universities at Berkeley and Stanford and the United States Geological Survey as well as others in the field the detailed information is rapidly accumulating.

The coast route from Los Angeles to San Francisco is in the coast range throughout the entire trip and affords an excellent opportunity to observe many of its features.

THE COAST RANGE OF OREGON

If in California we have in the Pacific system two ranges, the Sierra Nevada and the coast range, which are strongly contrasted in composition, structure and age, in Oregon we have two ranges of still

greater contrast, not only in composition, structure and age, but in mode of development.

The coast range of Oregon extends from Cape Blanco in Oregon through Washington to the strait of Juan de Fuca, a distance of nearly 400 miles. At the southern end it abuts against or rather runs into the Klamath mountains without any sharp topographic termination. At the north it ends in the Olympic mountains of bold relief, reaching an altitude of 8,150 feet, but not quite reaching the height of the Klamath Mountains. South of the Columbia along its crest are Onion Peak, Saddle Mountain and Mary's Butte, of which several are volcanic.

On the whole the range is a unit but irregular and, as compared with the Sierra Nevada and coast range of California, is characterized by its lack of effect upon drainage. Although of small extent, it is cut across by four rivers, the Umpqua, Nehalen, Columbia and Chehalis.

It is composed wholly of Mesozoic and Tertiary rocks which at both ends abut against those of the Paleozoic age. The Franciscan series of sandstones, shales and cherts of Franciscan age, with serpentine and other intrusives, form a large part of the Olympics and a portion of the southern terminus of the range in Oregon, but have not been recognized in intermediate portions of the range. The same is true of the Cretaceous, especially the Upper Cretaceous, which lies with marked unconformity upon the rocks of Franciscan age and thus records the great diastrophic epoch of compression, probably about the close of the Jurassic.

The Cretaceous on the Pacific coast was a time of subsidence so profound, at least in one locality, as to result in the accumulation of 29,000 feet of deposits in a moderately shallow sea which transgressed the sinking land until it reached the base of the Sierra Nevada. In Oregon there was apparently a great embayment covering not only the northern end of the Klamath Mountains, but extending inland beyond the Cascade range to the base of the Blue Mountains. This great sinking embayment, as it were in the lee of the Klamath Mountains, the stable and insular terminus of the Sierra Nevada, is an important feature of both the Cascade and the coast ranges in Oregon. The steeper inclination of the Cretaceous strata as compared with the Eocene indicates their unconformity, and the discordance is the greater in proportion as the underlying Cretaceous is older.

The Eocene sandstones and shales, although mainly marine, are in part of fresh or brackish water accumulation and contain locally more or less important deposits of coal. They form the bulk of the coast range in Oregon and southwest Washington, and with them are associated in many places contemporaneous volcanics, for the most part basalts.

A large part of the coast range in Oregon and Washington south of the Olympics was probably not raised above the ocean before the close of the Eocene, but at that time the elevation became somewhat more pronounced, forming a low ridge which with minor oscillations admitted the Miocene sea through the gateway of the Chehalis and Columbia into the Willamette Valley.

Toward the southern end, where the Eocene contains some marine sandstones derived from the near shore of the Klamath Mountains, the coast range is gently synclinal. It presents a bold bluff with even crest to the Umpqua Valley, possibly due to a fault. Although, as a whole, the coast range of Oregon has not been subjected to as great compression as that of

California, nor cut into parallel ridges by large faults, yet in places along the coast, as at Coos Bay, the thinner bedded Eocene has been folded and compressed into a vertical position. The later intermittent uplift during the Quaternary is recorded by a series of elevated beaches cut more or less deeply on the west slope by the ocean waves.

THE CASCADE RANGE

The Cascade range is essentially a volcanic range stretching from Lassen Peak in California to Mt. Rainier in Washington, a distance of 450 miles. At both ends the lavas lap up on to the uplifted mountains of older rocks, the Sierra Nevada in California and the northern Cascades in Washington, but between these two from the Columbia River in Washington to the Pit River in California, for a distance of nearly 300 miles, the range is composed largely, if not wholly, of igneous rocks that have escaped from a great belt of volcanoes that form the range. The summit of the range is an irregular plateau strewn with many lava and cinder cones, of which each one marks the site of a volcanic orifice tributary to the upbuilding of the range.

Where best developed, as shown in the Klamath and Columbia river sections, the body of lava forming the range is on the average probably about 4,000 feet in thickness, but in the greater volcanoes like Hood, Jefferson, Mazama, Shasta and Lassen it rises to accumulations of 6 to 10,000 feet in thickness. The later foundations of the Cascade range were laid in the Oregon embayment during the Cretaceous and early Tertiary times, possibly before the ranges were distinctly outlined. The Tertiary volcanic effusions began in Oregon west of the Cascade range during the Eocene and possibly a little later in the same epoch eruptions began in the base of the Cascade range. During the later Tertiary the volcanic activity was greatest and the bulk of the range, though partly uplifted, was in equal or perhaps even greater measure upbuilt by flows of viscous andesitic lavas with much ejected material. Basalts are common and some acid lavas are known, but the great bulk of the range is andesite in strong contrast with the great lava plains east of the Cascades, where the thin basalt flows spread out horizontally like sheets of water. The change from the plain to the mountain slope at the eastern base of the Cascade range is abrupt and distinct, and due, for the most part, to the fact that the stiff viscous andesitic lavas were able to build up steep slopes while the superheated and highly liquid basalts spread out like water along the irregular mountain front.

After the close of the Tertiary the volcanic activity waned, although eruptions occurred to within the historic period and possibly even to the present day if the outbursts from the summit of Lassen Peak develop so as to involve molten material.

However that may be, there is no doubt that the Cinder Cone and its lava field 10 miles northeast of Lassen Peak resulted from one or more eruptions within a century or two. In 1843 both Baker and St. Helens were in violent eruption, ejecting large quantities of ashes, of which Fremont obtained samples collected at the time of the eruption. There is also well-attested authority that eruptions occurred on Mt. Baker in 1854, 1858 and 1870. In general, however, the volcanoes of the Cascade range are considered extinct, and the upbuilding of the Cascade range completed as far as the actual accumulation of lava is concerned.

While the great altitude of the range is due chiefly to the piling up of lavas, a considerable portion is due to actual uplift, for in the Cretaceous of the Rogue River valley

marine shells now occur at the elevation of 3,000 feet which must have been elevated to that amount. The same may be said of the Eocene. It is, however, important to note that the uplifting of the Cretaceous and Eocene sediments about the close of the Tertiary was connected with the Klamath Mountains rather than that of the Cascade range.

Faulting that has played so large a rôle in the development of the Sierra Nevada and the coast range of California has not given general features to the volcanic mass of the Cascade range. Small faults are common in the lavas southeast of Lassen Peak, forming lines of bluffs and bringing the ground water to the surface in large springs, a feature which is common also in the Klamath Lake region and, as pointed out by Russell, along other portions of the range, but these small faults have no effect on the general form of the range.

Along the western base of the range in the Willamette Valley, Washburne has pointed out some features suggesting a fault, but as yet its existence is a matter of doubt. There is no great relief feature in that region that appears to have originated in faulting. Farther south in the Rogue River valley there is a regular practically conformable succession from the Cretaceous through the Tertiary sediments to the overlying lavas of the Cascade range. Small faults occur in the Eocene coal beds which dip beneath the range but the faults are connected with the local intrusion of the lavas and not of large extent connected with the uplifting of the range.

While it is evident that the lavas of the Cascade range are faulted, I think Russell has greatly overestimated the effect of the faulting as a factor in the upbuilding of the range, which, as it seems to me, is a great pile chiefly of viscous andesitic lavas from many confluent cone-capped vents, in strong contrast to the coneless basalt plains in the formation of which the high degree of fluidity in the outflowing lava was the most important factor.

THE GREAT VALLEY

Of all the relief features of our Pacific coast mountain belt the least impressive and yet the most important is the Great Valley where live by far the larger number of people, with railroads for transportation, and produce from the alluvial soil washed in from the adjacent mountain ranges the main portion not only of their own subsistence, but much for other parts of the world. The great valley extends throughout the entire mountain system, but not without interruptions, and in fact these interruptions are so marked in certain localities, as between the heads of the Sacramento and Willamette rivers, where the valley is obscured by cross folds from the Klamath Mountains, that some geologists have doubted its continuity. When these cross folds and their effect upon the great valley are clearly understood it will be recognized that the valley is the great feature of the Pacific mountain belt, with its history deeply buried in and beneath an enormous mass of sediments.

J. S. DILLER

U. S. GEOLOGICAL SURVEY,
WASHINGTON, D. C.,
December 10, 1914

THE INTERNATIONAL COMMISSION ON BOUNDARY WATERS

MR. ADOLPH F. MEYER, associate professor of hydraulics in the college of engineering of the University of Minnesota, has been engaged as consulting engineer for the International Joint High Commission, in connection with investigations made on boundary waters. These investigations have extended over the past two and a half years, and in this work Professor Meyer has been associated with Mr.

Arthur V. White, of the Conservation Commission of Canada. This gives the United States one consulting engineer and Great Britain a second. The work has involved extensive investigation relating to the regulation of the levels of the Lake of the Woods, and the utilization of the waters tributary to that lake. Water power and water supply, navigation, fishing and agriculture are the chief interests concerned. Minnesota is vitally interested in this investigation inasmuch as about 11,000 square miles of the drainage basin of the Lake of the Woods lie in this state.

A dam controlling the level of the Lake of the Woods is located in Canadian territory. The shores of the lake on the Canadian side, particularly in the vicinity of the dam, are very high, but on the Minnesota side the slope of the land toward the lake is only a few feet per mile.

Settlers have been complaining to the United States government that the lake has been materially raised and that much of their land is being flooded. The first complaints were made more than twenty years ago. During the wet year of 1905 renewed protests were sent to the Department of State, but all efforts at securing settlement through diplomatic channels failed, until finally, soon after the appointment of the International Joint Commission in 1910, this question of the regulation of the levels of the Lake of the Woods was referred to this commission.

The International Joint Commission is a permanent tribunal with powers of adjudication, created by treaty between Great Britain and the United States. While the work of this commission thus far has concerned primarily the use of boundary waters along the Canadian frontier, the powers conferred by the treaty are very broad and include, in fact, the decision of practically all matters of dispute between citizens of the United States and Canada, referred to this body by their respective governments.

All obstructions or diversions of boundary waters affecting the natural level or flow of such waters on either side of the line must receive the approval of this commission.

One of the important questions decided by the commission during the past year was that of the application of the power companies at Sault Ste. Marie, for approval of the obstruction, diversion and use of the waters of the St. Marys' River for the development of power. Another important question now under investigation by the commission is that of the pollution of boundary waters.

THE AMERICAN AMBULANCE HOSPITAL IN PARIS

Western Reserve University is the first to respond to a suggestion made by officers of the American Ambulance Hospital in France, that leading American medical schools send to France corps of men to take charge of one of the hospital's services of 150 beds. The medical board of the American Ambulance Hospital, through Dr. Joseph Blake, has requested Dr. Crile to be the leader in the proposed plan. The expedition will be financed by the trustees and friends of the university and the Lakeside Hospital and left for France on December 30.

The American Ambulance Hospital was established by the trustees of the American Hospital at Paris almost immediately after the outbreak of hostilities. Ambassador Myron T. Herrick was actively interested in the project and the building of the Lycèe Pasteur at Neuilly was secured. The present capacity of the hospital is 450 beds, divided into services of 150 beds each. The suggestion made by the medical board is that several of the leading medical schools of the United States send out staffs to take charge in succession of one of the hospital services of 150 beds, with operating rooms and equipment, for periods of three months each. According to the proposed plan the corps from the several universities would follow one another without interruption of service. The officials of the Ambulance Hospital believe that the opportunity is unrivalled for humanitarian service and for clinical experience and medical research.

Dr. du Bouchet is the executive head of the hospital and represents the institution with

the French war office. He also has one of the three services, which he directs personally. Dr. Crile will have free latitude in his own service to carry it on in any way he may desire.

The personnel of the Western Reserve University expedition includes:

Dr. George W. Crile, professor of surgery in Western Reserve University and visiting surgeon of Lakeside Hospital.

Dr. Samuel L. Ledbetter, Dr. Edward F. Kieger and Dr. LeRoy B. Sherry, now of the resident staff of Lakeside Hospital, who will act as assistant surgeons and clinical assistants.

Dr. Lyman F. Huffman, of the resident staff of Lakeside Hospital, who will act as clinical pathologist.

Dr. Charles W. Stone, assistant professor of nervous diseases in Western Reserve University and visiting neurologist of Lakeside Hospital.

Miss Agatha Hodgins and Miss Mabel L. Littleton, anesthetists.

Miss Iva B. Davidson and Miss Ruth J. Roberts, from the operating room staff of Lakeside Hospital.

Dr. Crile takes with him also, to assist in a special research, Miss Amy F. Rowland, B.S., Mt. Holyoke College, and William J. Crozier, Ph.D., fellow of the department of zoology of Harvard University.

CHARLES SEDGWICK MINOT

AT the meeting of the council of the American Association for the Advancement of Science held in Philadelphia on December 29, a minute was adopted in memory of Dr. Minot. Dr. Eliot, who was in the chair, stated that he had been associated with Dr. Minot for more than thirty years in the work of the Harvard Medical School and added a fit tribute of appreciation. The minute, which was presented by Professor Cattell and adopted by a rising vote, is as follows:

The council of the American Association for the Advancement of Science places on record its sense of irreparable loss in the death of Charles Sedgwick Minot and its appreciation of the value of his services to science, to education and to human welfare. Endowed with the best New England blood and traditions, trained there and in the schools of France and Germany, keen in intellect, wise in counsel, sure in action, sincere in friendship, he devoted his life to the advancement of science, the improvement of education, and the betterment of the agencies on which science and education depend. His contributions to embryology, anatomy and physiology gave him leadership in those sciences; his high ideals of education aided in advancing the standards of medicine in America and in placing the Harvard Medical School in its commanding position. Not only by his original researches, by his masterly books and by his fine addresses and lectures, but in countless other ways he helped his fellow-workers in science —in the construction of microtomes; in the establishment of a standard embryological collection; in the improvement of bibliographical and library methods; in the unit system of laboratory construction, followed in the beautiful buildings of the Harvard Medical School; in the early development of the Marine Biological Laboratory at Woods Hole; in the Boston Society of Natural History, of which he was president for many years and until his death; in the Wistar Institute for Anatomy and Biology; in the administration of the Elizabeth Thompson Science Fund and the Bache Fund of the National Academy of Sciences; in international relations, as when visiting professor to Germany and in the foreign publication of his books; in the editing of SCIENCE and of journals of anatomy, zoology and natural history; in the founding and the conduct of the American Society of Naturalists and the Association of the American Anatomists; in the establishment of the convocation week meetings of scientific societies; for us especially by his leading part in the work of the American Association for the Advancement of Science, of which he was secretary of section, general secretary, twice vice-president, president, a constant member of the council, at the time of his death chairman of the committee on policy. In the American Association, as elsewhere, Charles Sedgwick Minot leaves a vacant place which can never be filled. We take up our work sadly in his absence; but we know that it will in all the years to come be more fruitful for the heritage of his service.

SCIENTIFIC NOTES AND NEWS

AT the Philadelphia meeting of the American Association for the Advancement of Science Dr. W. W. Campbell, director of the Lick Observatory, was elected president for the

meetings to be held this year in San Francisco and Columbus.

Presidents of several of the scientific societies meeting in Philadelphia last week were elected as follows: The American Society of Naturalists, Dr. Frank R. Lillie, professor of embryology in the University of Chicago; Geological Society of America, Dr. E. O. Ulrich, U. S. Geological Survey; American Psychological Association, Dr. John B. Watson, professor of psychology in the Johns Hopkins University.

The American Mathematical Society, meeting in New York on January 1 and 2, elected to the presidency Professor E. W. Brown, of Yale University.

Dr. John Dewey was elected president of the American Association of University Professors which was organized in New York City on January 1 and 2.

The gold medal of the Geographical Society of Chicago has been awarded to Colonel George W. Goethals. It will be presented to him at a dinner to be given by the society on January 23.

The Austrian Academy of Sciences has given Professor Wagner v. Jauregg $1,250 for his research on the etiology of goiter; Professor Honigschmid, of Prague, $600, for his studies of the atomic weight of the radium elements, and Professor Netolitzky, of Czernowitz, $375 to continue his study of the history of foodstuffs.

Mr. E. J. Cheney, one of the assistant secretaries of the British Board of Agriculture and Fisheries, has been appointed to the office of chief agricultural adviser, and Mr. F. L. C. Floud to be an assistant secretary.

It is stated in *Nature* that Professor T. A. Jaggar, director of the Hawaiian Volcano Observatory, and a group of his assistants, had a narrow escape of their lives during a recent ascent of Mauna Loa. The volcano had become active, discharging large quantities of lava. The scientific party, while making an ascent to study the eruption, was caught in a snowstorm and nearly overwhelmed by snowslides almost in the path of the lava streams.

The well-known paleontologist, Professor Otto Jaekel, of Greifswald University, Germany, and a member of the Landwehr, was wounded in one of the battles of the Yser Canal, and is now recuperating at his home.

Dr. Lee M. Barney, formerly of Elkhart, Ill., but more recently of Miami, Fla., has been awarded damages of $41,500 from the casualty companies on account of the loss of sight from a chemical explosion which occurred while he was making experiments in his laboratory.

Professor John J. Flather, head of the department of mechanical engineering of the college of engineering of the University of Minnesota, is spending a year's leave of absence in Scotland. He has recently moved from Girvas, which is on the seashore, to Edinburgh, his address being 20 Greenhill Place.

Dr. R. R. Dinwiddie, pathologist and bacteriologist of the Arkansas University and Station, who has been connected with the institution since 1887, has resigned with the intention of retiring from active service.

Lyman Carrier, agronomist since 1907 in the Virginia College and Station, has accepted a position with the office of forage crop investigations of the Department of Agriculture, and has been succeeded by T. B. Hutcheson, associate professor in plant breeding in the University of Minnesota.

Dr. Harvey Cushing, professor of surgery in Harvard University, delivered an illustrated lecture on "The Portraits of Vesalius," on the evening of December 29 at the Army Medical School, Washington.

Professor Edward L. Nichols, of Cornell University, delivered an illustrated lecture on "Artificial Daylight," at the forty-seventh annual meeting of The Kansas Academy of Science, which was held in Topeka on December 22.

On December 11 Professor H. B. Ward, of the University of Illinois, lectured before the Washington University Chapter of the Society of the Sigma Xi on the "Homing of Fishes."

THE Geographic Society of Chicago holds a meeting on January 8, at which an illustrated lecture by Miss Dora Keen, of Philadelphia, will be given, entitled "Across Paraguay."

THE Washington Academy of Sciences held a joint meeting with the Botanical Society of Washington on January 5, to hear an illustrated lecture by Professor J. C. Bose on "The Response of Plants."

PROFESSOR C. S. SHERRINGTON, Fullerian professor of physiology at the Royal Institution, will deliver a course of six lectures at the institution on muscle in the service of nerve, during January and February.

THE Hunterian oration of the Royal College of Surgeons of England will be delivered by the president, Sir Watson Cheyne, on February 15.

MRS. WALLACE, widow of Dr. A. R. Wallace, died at Broadstone, Dorset, on December 10, after a long illness.

PROFESSOR JAMES HARVEY PETTIT, professor of soil fertility in the college of agriculture and chief of soil fertility in the experiment station of the University of Illinois, died on December 30 at Pasadena, California, where he was spending a leave of absence in the hope of benefiting his health. Dr. Pettit received his bachelor's degree at Cornell in 1900 and his doctor's degree at Göttingen in 1909. Since 1901 he had been connected with the University of Illinois. He was a member of the American Chemical Association and American Association for the Advancement of Science.

MR. W. W. ROCKHILL, known for his explorations in China and Tibet under the auspices of the Smithsonian Institution, and the author of several works on this and other Oriental subjects, has died at the age of sixty years.

DR. C. R. CRYMBLE, of University College, London, a fellow of the Chemical Society, has been killed in the war.

DR. A. VAN GEUCHTEN, professor of anatomy and neuro-pathology at Louvain University, has died at Cambridge.

M. LÉON VAILLANT, doctor of medicine and of sciences, formerly professor at the Faculté des sciences de Montpellier and honorary professor of the Museum of Natural History at Paris, has died aged eighty years.

AMONG examinations announced by the New York State Civil Service Commission, applications for which must be received by January 15, are the following: Physiological chemist, State Department of Health. Salary $1,800 to $2,500. Applicants should have a thorough knowledge of the principles of organic and physiological chemistry. They must have had at least three years' practical experience in physiological or biological chemistry. Open to men and women, non-resident and non-citizens subject to the usual rule giving preference in certification to citizens and residents of New York state.—Bacteriologist and assistant bacteriologist, State Department of Health. Two lists will be established as a result of this examination: one eligible to appointment as either bacteriologist or assistant bacteriologist at a salary of $2,000, open only to men who have the degree of doctor of medicine; the other eligible to appointment as assistant bacteriologist only at salaries ranging from $1,200 to $1,500, open to both men and women. Applicants should have a thorough knowledge of the principles of bacteriology and must have had considerable practical experience in the bacterial diagnosis of infectious diseases, and a general knowledge of clinical microscopy and of gross and histological pathology is desirable.—Assistant chemist, Agricultural Experiment Station, Geneva. Salary $1,200. There are two vacancies: For the first, candidates must be college or university graduates with special training in chemistry, including advanced analytical chemistry, analysis of agricultural materials such as fertilizers, feeds, crops, etc., together with some training in the microscopic identification of vegetable tissues with special reference to the constituents of feeds. For the second vacancy, the requirements are similar to those for the first except that training in microscopical identification is not required. Open to non-residents, subject to usual rule.—Chief surveyor, Conserva-

tion Commission. Salary $2,400. The appointee to this position must have had wide experience as a surveyor of Adirondack lands. He is called and is relied upon as an expert witness in title disputes and he must therefore have had wide experience in Adirondack surveys, including experience in running boundary lines.

A South American Expedition, which will work under the joint auspices of the Field Museum of Chicago and the New York Museum of Natural History, has sailed on the United Fruit liner *Metapan,* going first to La Paz, Bolivia. From La Paz, the party will cross the Andes by pack train, and descend into a section of Bolivia which is entirely new to the collector. The party will descend either the Beni or the Mamore Rivers, and eventually reach the Amazon by the Madeira. The party consists of Messrs. Lee Garnett Day, Alfred M. Collins, George K. Cherrie, Robert H. Becker and W. F. Walker. Mr. Day has traveled in the Orient and in Brazil. Mr. Collins during the past two years has made hunting trips in South Africa and the Arctic regions north of Siberia. Mr. Cherrie accompanied the Roosevelt expedition last season, and has collected for the British Museum, the New York Museum of Natural History and the Field Museum of Chicago. Mr. Robert H. Becker has just returned from the Amazon Valley and southern Brazil, where he collected for the Field Museum.

Dr. Frank Billings, Chicago, has been invited to deliver the Lane lecture for 1915. The *Journal* of the American Medical Association gives the list of previous lecturers, which is as follows:

1896. Sir William Macewen, regius professor of surgery, University of Glasgow. "Surgery of the Brain."

1897. Christopher Heath, professor of clinical surgery, University College, London. "Congenital Malformations, Aneurism and other Surgical Topics."

1898. Thomas Clifford Allbutt, F.R.S., regius professor of physics, University of Cambridge, England. "Diseases of the Heart."

1899. Nicholas Senn, professor of surgery, Rush Medical College, Chicago. "Topics in General Surgery."

1900. Sir Michael Foster, professor of physiology, Cambridge, England. "History of Physiology."

1901. Sir Malcolm Morris, surgeon, skin department, St. Mary's Hospital, London. "Social Aspects of Dermatology."

1902. Sir Charles B. Ball, regius professor of surgery, University of Dublin. "Diseases of the Rectum."

1903. Oscar H. Allis, Philadelphia, Pa. "Dislocations and Fractures Involving Larger Bones."

1904. William H. Welch, professor of pathology, Johns Hopkins University, Baltimore. "Infection and Immunity."

1905. Sir Patrick Manson. "Tropical Diseases."

1906. John C. McVail. "Practical Hygiene, Epidemics and Preventive Medicine."

1910. Reginald Heber Fitz, Hersey professor of theory and practise of medicine, Harvard University, Boston. "A Consideration of Some Features of the Lymphatic System."

1911. E. Fuchs, professor of ophthalmology, University of Vienna. "Importance of Ophthalmology in Its Relation to Systemic Disease."

1913. Edward Albert Schaefer, professor of physiology, University of Edinburgh. "Internal Secretion."

UNIVERSITY AND EDUCATIONAL NEWS

The sum of $2,430,000 was obtained for Wellesley College in the fourteen months just ended, according to a statement given out by the treasurer. Of this amount $430,000, including a conditional pledge of $200,000 from the General Educational Board, was raised before the fire of March 17, when College Hall was burned. The remaining $2,000,000 includes a pledge from the Rockefeller Foundation of $750,000. Only three gifts of over $10,000 have been received since last August. One of these was made but ten days ago, and was a gift from Mr. Carnegie of $95,000 for the enlargement of the library.

The Massachusetts Institute of Technology has received in gifts during the past year the sum of $400,000, besides two items wherein the institute is residuary legatee, and the amounts have not been determined. Following is the list: Bequest of Caroline L. W.

French (outright), $100,000; (residue), $100,000; Lucius Tuttle, $50,000; Nathaniel Thayer, $50,000; William Endicott (residue), $25,000; Matilda H. Crocker (outright), $20,000; (residue), $20,000; Mrs. W. A. Abbe, $10,000; gift for George Henry May scholarship, $10,000; gifts for research in a number of amounts, $10,000.

OHIO UNIVERSITY, Athens, Ohio, has just put into service its $15,000 electric light and power plant. The boiler plant was previously installed in connection with the central heating system, and the above sum covered the cost of other station equipment, underground cables connecting the station with the various buildings, and the necessary transformers. The total capacity of the plant is nearly 400 horsepower.

THE complete report of the proceedings of the First National Conference on Universities and Public Service has been printed, extending to 350 pages. Copies will be sent free to trustees and other university officers, public officials, editors and librarians. To others it will be sent at cost of publication on application to Edward A. Fitzpatrick, Box 380, Madison, Wisconsin.

H. J. PATTERSON has resigned as president of the Maryland College and Station, to take effect July 1, 1915, recommending in his letter of resignation the abolishing of the office of president and the substitution of an administrative commission consisting of a director of college work, the director of the station, and the director of extension work. This plan is under consideration by the board of trustees.

DISCUSSION AND CORRESPONDENCE

FRATERNITIES AND SCHOLARSHIP

THE communication on "Fraternities and Scholarship" published in a recent number of SCIENCE[1] touches a problem of decided interest—the relation of fraternities to the welfare of our higher institutions of learning—and one which has received much attention during the past few years, particularly in the universities and colleges of the south and west. The treatment of the question by the writer who happens to be the assistant dean for men in the University of Illinois, although presented in a very "readable" form, leaves much to be desired however from even an elementary statistical standpoint, and the reader may well hesitate as to the conclusions to be drawn from the data presented, beyond the idea that fraternities may be taught to appreciate the high grades which are assumed to represent scholarship. Perhaps the demonstration of a proposition of this nature is sufficient, for the opportunity to thus influence men separated into groups competing with one another, goes far toward justifying the existence of such groups even though they may have certain shortcomings.

While among all men students (2,600) there is an increase in the average grade from 81.1 per cent.[2] for the first semester of 1909–10 to 82.3 per cent. for the second semester of 1913–14 and among fraternity men (700) from 78.7 per cent. to 81.9 per cent. for the same period, the actual increase during the five years is less, inasmuch as average second semester grades are in every case higher than first semester grades of the same college year, a result undoubtedly due to the elimination of the poorer students at the end of the first semester. Therefore similar semesters should be compared and the gain is from 81.4 per cent. to 82.3 per cent. for all men students—relatively 1.11 per cent.—and from 79.7 per cent. to 81.7 per cent. for fraternities—relatively 2.51 per cent.

This is really a small increase to result from a five-year propaganda and when taken into consideration with other factors which may have been instrumental in bringing about the result, one might wonder as to whether the smoke denoted a fire. The plotting of graphs with relatively long ordinates often conveys a misleading impression.

For the second semester of 1910–11 to the second semester of 1913–14 there is practically no gain for the average grade of all students while fraternity students exhibit a gain ap-

[1] SCIENCE, October 16, p. 542.

[2] Approximations from the published chart.

proximating 1.7 per cent. relatively. Consequently the non-fraternity graph—which unfortunately was not published—must have tended downward. The interpretation of this result seems not to have been considered in the paper and if we accept the interpretation of the data as a whole as due to the greater interest by fraternities in grades, the downward movement of the plotted line is undoubtedly due to the transfer of men to the one group at the expense of the other group. Thus one might well regret that there were not subdivisions Alpha, Beta, Gamma, etc., in the non-fraternity group in order to see if the competition engendered would not raise the average grade of all, instead of permitting one to draw on the other for resources.

The statement is made that

> in 1909 the chapters were widely scattered up and down the scale, and in 1914 they are closely grouped around the fraternity average. This fact means undoubtedly that during the interval between these years the fraternities have intensified their attention to scholarship.

Such an opinion evidently based on the range between chapters with the maximum and minimum grades, which happens to be smaller in 1914, is of course no criterion of "scatter" as ordinary inspection should have demonstrated. Computing the coefficient of variation based on chapter units, it may be found that this has a value in 1909 of $2.44 \pm .99$ per cent. and in 1914 a value of $2.02 \pm .95$ per cent., a negligible difference.

It would have been of considerable interest to have presented data for a discussion of the possible effect the increased interest by students in their marks might have had on grading by the faculty although the latter will deny it and even charge that such a suggestion is heresy. Nevertheless it is not at all impossible that the average gain of 1.11 per cent. for all students is connected with a factor of this nature, however unconsciously the result may have been brought about.

The whole question as to the value of grades as a criterion for scholarship and efficiency in our higher institutions of learning, particularly where based on frequent examinations throughout the semester, is still an open one, although several interesting papers bearing on the subject have been published. While the individual who would normally "loaf" is thus compelled to retain bookish facts temporarily, there are others in which a distaste for a subject results from such methods. It is evident however that until the grade of instruction in our secondary schools is brought to a much higher standard, we are not in a position to adopt the plan of the German universities and require a single examination period as a preliminary to the conferring of the degree.

The publication of data relative to efficiency in college instruction is to be commended, but the interpretation of the facts will often present many difficulties. The methods of correlation are adapted to solving numerous problems in pedagogy, and it is to be hoped that not only from the University of Illinois but also from a large number of other institutions may data be presented with a clear mathematical treatment.

L. B. Walton

Kenyon College,
Gambier, O.

Sentiment versus Education

For many years our principals, in secondary schools, have been dinning into the ears of the teachers the order to teach, not to "hear recitations." The same bureaucrats have urged the teachers to help the dull ones, letting the bright ones find their own way. It has resulted that by the time the teacher has gone through the five formal steps the bright students know enough to make a passable recitation the next day, at least if the teacher proves as "helpful" as the custom of the school requires. The dull ones know that the matter will be gone over and over again and they see no necessity to study. The teacher has displaced the text-book.

Our pupils do not secure the power to get the meaning of any passage more complex than what we find in the daily paper or popular novel. This is partly due to the fact that the teacher is ordered to use "simple language, the language of all great writers."

We have to define efficiency by "work out divided by work in." The teacher has also replaced the dictionary.

Our school work in what is called, from custom, reading seems to consist in reciting some "pieces," very ultra-modern, calling for some acting and a little thought. Later the pupils are required to learn what some critic has said about the great works, with perhaps extracts from the professor's doctorate thesis. It is then certain that the pupil will not read any of the books which he has heard called classics.

A teacher found that his pupils could not get what was in the book. They said: "Why do the books not present the matter as you do?" He wrote the book; he reported that the reviewers said that it was about as dry a book as they had ever seen.

JOHN N. JAMES

INDIANA, PA.

THE COTTON WORM MOTH

I WAS interested in Professor Fernald's note on the cotton worm moth in your issue of November 27. Professor Fernald reports that few of these moths were taken in Massachusetts in 1912. Now in 1912 we had a great flight of them here, the only invasion on a large scale that I have heard of in this locality. They were here by the tens of thousands, literally covering the ground for a space of 100 square feet or so under some of the street lights.

The moths arrived on the night of October 10; the night watchman in the village told me they came in all at once at about 3 A.M. and flew for a time in such swarms round the electric lights "that you couldn't see the lights for the moths." They were reported in large numbers in at least one other village near here; and my father who was then living in London, Ontario, wrote me that there had been an invasion there which arrived two or three days earlier than ours here, but which must have been on the same large scale as to numbers.

It would be interesting to know whether these were parts of the same front, or separate swarms moving independently.

In 1913 I saw none here, but during the past autumn there were a few specimens, though I have no record of the date of their appearance.

A. P. SAUNDERS

CLINTON, N. Y.

METEOROLOGICAL OBSERVATIONS IN GERMANY

A LETTER dated Berlin, November 30, 1914, from Professor Dr. Gustav Hellmann, director of the Royal Prussian Meteorological Institute in Berlin, advises us that the usual regular observations are being maintained without interruption throughout the German Empire. So far as the internal weather forecasts for Germany are dependent upon cable reports from foreign countries they are made with difficulty; all such reports are at present interrupted, even those from Iceland, since the latter come over a Danish cable that lands at Aberdeen where they are suppressed and are not permitted to reach even Copenhagen. The regular, though belated arrival of the *Meteorologische Zeitschrift*, together with other scientific publications show that the German scientific world is far from suspending its existence during its present struggle.

C. ABBE, JR.

SCIENTIFIC BOOKS

An Account of the Mammals and Birds of the Lower Colorado Valley, with Especial Reference to the Distributional Problems Presented. By JOSEPH GRINNELL. University of California Publications in Zoology, Vol. 12, No. 4, pp. 51–294, Pls. 3–13, 9 text figures, March 20, 1914.

The report before us gives the results of an expedition undertaken in the spring of 1910 by the California Museum of Vertebrate Zoology. Since the founding of this museum by Miss Annie M. Alexander, in 1908, Grinnell and his staff have spent much of their time in the field, accumulating extensive series of specimens, representing the fauna of California and adjacent states, and

of the coast region as far north as Alaska. This valuable material has been collected largely with a view to the study of geographic variation. Throughout that time, and indeed for a much longer period, the author of the present report has been active in describing and subdividing species of Pacific Coast birds and mammals.

A considerable proportion of the vertebrates of this region are represented in different parts of their range by different local races, for which the term "subspecies" has gained general acceptance. Indeed, the process of "splitting" in these groups has been carried to such lengths that a large majority of the birds and about three fourths of the mammals listed in the paper here considered are designated by trinomials. Outside of taxonomic circles the feeling is sometimes expressed that these trinomials stand for more or less fictitious entities, the product of minds in which the passion for detecting differences has almost reached the stage of paranoia. In quite a different spirit is Bateson's recent advice to the systematists to "subdivide their material into as many species as they can induce any responsible society or journal to publish," since "the collective species is a mere abstraction, convenient indeed for librarians and beginners, but an insidious misrepresentation of natural truth."[1] Whether these ultimate subdivisions are termed species or subspecies is, of course, a matter of secondary importance. The main thing is that they should be described and named.

It is probably no mere accident that several of the leading exponents of the "isolation" theory of specific differentiation have done much of their field work on the Pacific Coast of North America. Here the subdivision of the earth's surface by means of natural barriers is carried to an extreme probably not elsewhere found within the limits of the United States. It is true that in many cases the areas thus marked off differ very greatly in their climatic conditions, as witness the abrupt change which we encounter in crossing the mountains from the Mojave Desert to the orange belt of southern California. Any specific differences which are met with on the opposite sides of such a barrier might be attributed to environmental differences acting directly or indirectly. Such cases do not, of course, prove anything as to the efficacy of isolation *per se* in giving rise to divergent descent lines.

In the lower Colorado River, however, Grinnell finds what he regards as a critical instance. Here is a river, bordered on each side by a vast expanse of desert, uniform in its character for great distances, whether to the right or left. Considered as a physical environment, the California side of the river is identical with the Arizona side. Yet of the 23 species of rodents collected in the valley of the Colorado by the museum expedition of 1910 Grinnell and his party found 8 which were absolutely restricted to one or the other side of the river. These last were all strictly desert-dwelling forms which probably never visit the water's edge. On the other hand, the inhabitants of the lower reaches of the river bottom were found to be in every instance common to the two banks.

The case upon which the greatest stress is laid is that of two species of ground-squirrel, belonging to the genus *Ammospermophilus*. Twenty-four specimens of *A. harrisi harrisi* were captured at scattered points on the Arizona side of the river, while seventeen specimens of the closely related *A. leucurus leucurus* were taken on the California side, the two occupying the same "ecologic niche" in their respective territories. In no case was a single individual found on the "wrong" side of the river. These two species were seen at points only about 850 feet apart in a direct line. Commenting on this case, Grinnell remarks:

> The sharp separation of the ranges of [such] nearly related vertebrates by a barrier of such narrow width is, to the best of the writer's knowledge, not known elsewhere in North America.

The author makes the assumption common to both Lamarckians and Natural Selectionists that morphological differences must, in some

[1] Bateson, "Problems of Genetics," Yale University Press, 1913.

way, result from environmental differences. But, in this instance, "the climatic features (zonal and faunal, as well as associational) are identical on the two sides of the river." Therefore, it is "reasonable to presuppose separate and rather remote centers of differentiation, and convergent dispersal through time and space which brought the resulting types to the verge of the river, beyond which they were unable to spread." It is needless to point out that hypotheses exist, *e. g.*, that of "mutation," which do not invoke the aid of environmental differences to account for all specific change. According to such a view, the "remote centers of differentiation" could be dispensed with.

If, as Grinnell believes, the two sets of animals "have undoubtedly descended from ancestral lines, which have invaded the territory from the two opposite directions," already specifically distinct, we can not see the force of the conclusion that "adequate ground is afforded for the belief that intervention of barriers is a prime factor in the differentiation of species." All the evidence shows in this case is that the barrier has kept these species apart. It may have had nothing to do with their differentiation as species. Indeed, in the absence of experimental evidence, we can not even affirm with certainty that any physical barrier has been necessary for the continued maintenance of their specific distinctness. It is not impossible that a high degree of sterility would be found to exist between the California and the Arizona species. Nevertheless, the facts, as described, are of great interest. Further expeditions should be sent into the valley of the Colorado for the express purpose of testing some of these important questions. And the work should be done before nature's original scheme of distribution has become hopelessly muddled through man's agency.

Grinnell recognizes "three distinct orders of distributional behavior as regards terrestrial vertebrates." First,

> every animal is believed to be limited in distribution *zonally* by greater or less degree of temperature, more particularly by that of the reproductive season. . . . When a number of animals (always in company with many plants similarly restricted) approximately agree in such limitation, they are said to occupy the same life-zone.

Throughout this and many other papers by the same author the "life-zone" conception plays a prominent rôle. The zones recognized by C. Hart Merriam are adopted by Grinnell, and their existence accepted as a fundamental datum, without the necessity of their being justified to the reader. The author believes, following Merriam, that the position and extent of these "zones" is determined by temperature conditions. Yet it is obvious that, throughout considerable portions of the continent, the details of temperature distribution are not known with any approach to precision. Thus, the actual criterion which the field zoologist falls back upon in any given case is the character of the fauna and flora which he finds associated together. The presence of certain species shows him that he chances to be in this or that "life-zone." It is assumed, though apparently seldom verified, that wherever these particular species occur in conjunction, the temperature conditions are in some essential respect similar.

It would seem *a priori* that in traveling along a uniform gradient from a region of higher to one of lower average temperature, or vice-versa, one would continually pass into and out of the ranges of species which found their limits of physiological adaptability at different points along the line. One would scarcely expect to encounter critical points, where the fauna and flora as a whole, or at least the most characteristic members of it, were suddenly replaced by a quite different assemblage. Yet this is the essence of the "life-zone" conception.

It would be foolhardy, indeed, for a zoologist of limited field experience to criticize this conception. It is doubtless based upon extensive and accurate observations and represents real facts. But unfortunately they are, in a high degree, facts which, by their very nature, are scarcely communicable to most biologists. Before the life-zone conception can be of much service to the average student of evolutionary problems it will have to be expressed in terms

which he is able to comprehend without making extended explorations, under the personal escort of one of the initiated. Until then, such expressions as "Upper Sonoran," "Transition" and the like will be to him mere empty names, or at best, they will recall to his mind certain colored areas, on a map of North America, the boundaries of which seem to have been chosen quite arbitrarily.

The second type of "distributional behavior" recognized by Grinnell is that which he terms "faunal." The various life-zones are each subdivided into a number of "faunal areas" (or, more simply, "faunas"), "on the causative basis of relative uniformity in humidity." We must, at the outset, question the wisdom of appropriating the word "fauna" for use in such a restricted and technical sense, particularly since quite a variety of meanings have already been attached to it by previous writers.

Grinnell regards it as "probable that every species is affected by both orders of geographic control" (*i. e.*, temperature and humidity), though believing the influence of temperature to be the greater of the two. While this belief in the rôle played by humidity does not appear to be based, in any single case, upon exact observational data, it would surely be unreasonable to throw it out of consideration on that account. One does not require an accurate hygrometer to sense the difference in humidity between the atmosphere of the redwood district of northwestern California and that of the Mojave Desert. We can not help wondering, however, whether sufficient care has been taken to disentangle the effects of atmospheric humidity from those of rainfall and soil humidity. Regions of high atmospheric humidity *may* be regions of high rainfall as well, but the reverse is not infrequently true, as witness the coast of southern California. It is a matter of common knowledge that vegetation is far more affected by the though the latter is also an important factor.[2] moisture of the soil than by that of the air,

[2] Transeau (*American Naturalist*, December, 1905) contends that the controlling influence for plants is the ratio of rainfall to evaporation.

Since the distribution of animals is so largely conditioned by that of plants, the indirect effects of rainfall and soil humidity upon the fauna of a region are beyond doubt. With rodents and other burrowing animals it seems not unlikely that the effects are much more direct.

The third "category of distributional control" recognized by Grinnell is that which he terms "associational." By "associations" he means "tracts of relatively uniform environmental condition, including their inanimate as well as living elements." They are, of course, subdivisions of a "fauna," just as "faunas" are subdivisions of a "life-zone." The "association" proper to a species represents its habitat, in the narrower sense, as distinguished from its geographical range. It is here that we find the most conspicuous correlation of the "so-called adaptive structures of animals . . . with certain mechanical or physical features of their environment."

The associations considered in the present report are all (except one) named for some characteristic plant, and, in fact, the term itself is borrowed from the botanists, by whom this conception was first developed. Ten of these associations are distinguished in the lower Colorado Valley traversed by the expedition under consideration. This whole region, however, belongs to the "Colorado Desert Fauna" and to the "Lower Sonoran Life-Zone."

The report contains a considerable fund of valuable ecological detail, palpably based upon careful observation, and in a large degree coordinated, so as to lead to conclusions, or at least to definitely formulated problems. In this last respect it stands in gratifying contrast to the recent output of some of the professed exponents of the science of ecology. A highly interesting special instance is Grinnell's discussion of associational restriction, as illustrated by the various species of pocket-mice (*Perognathus*). Here a truly quantitative mode of treatment has been resorted to, and very instructive results reached, despite the comparatively small number of individuals.

If nothing more, they point out a promising method of detecting and measuring associational preferences among animals which may be readily trapped.

The evolutionary theories of Darwin and Wallace were largely founded upon personal observations of geographical distribution. The modern student of genetics, on the contrary, carries on his studies for the most part in the laboratory and the breeding pen. It is significant, therefore, that Bateson,[3] perhaps the foremost living Mendelian, devotes a considerable portion of a recent volume to the problems of geographic variation. And one can hardly read that volume attentively without being convinced that the field naturalist holds the key to some of the most important secrets of nature. It is not improbable, therefore, that works of the sort here reviewed will come to receive more serious consideration from those who are concerned primarily with the problems of organic evolution.

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Chemical Technology and Analysis of Oils, Fats and Waxes. By DR. J. LEWKOWITSCH. Edited by GEORGE H. WARBURTON. Vol. II. 1914. Pp. 994. $6.50.

The first volume of this work appeared in this country while the author lay dead. While the death of an eminent chemist is always to be regretted, in this case there was an additional reason for regret—the delay, or worse yet, the possible non-appearance of the remainder of the treatise. The delay has been so slight as not to be noticed and the editorial work has been most satisfactorily performed by Mr. Warburton, who for seventeen years was associated with Dr. Lewkowitsch in his analytical practise.

This volume has been increased in size by thirteen per cent.; important additions have been made in the articles on linseed, tung, soy bean, cocoanut oils and candelilla wax, as well as minor additions to other portions to bring them thoroughly up to date.

The work may fairly be described as monumental; nothing would seem to have escaped attention. Even the toxicity of the different chlorides with two atoms of carbon has been given, as having a bearing on their technological uses.

Notwithstanding the very full table of contents, the reviewer misses, and must wait a year perhaps for, an index which it would seem advisable to include in each volume. Similarly the reviewer is inclined to question the advisability of including the large amount of statistical matter about the commercial side. That, it would seem, might well form the subject of a single volume, like the author's "Laboratory Guide to the Fat and Oil Industry" and be revised and brought up to date more frequently. If the work continues to grow as it has in the past, it would seem worth while to consider its publication by some society, as its compeer "Beilstein" has been taken over by the German Chemical Society.

A. H. GILL

[3] *Op. cit.*

SPECIAL ARTICLES

THE NITROGEN NUTRITION OF GREEN PLANTS

IT is the teaching of botanists that green plants obtain their nitrogen chiefly in the form of nitrates, though ammonium salts may be utilized to some extent by certain plants at least. Exceptions to this general rule are those plants provided with root-tubercles (and bog plants and others which have mycorrhiza?). These plants obtain their nitrogen in the form of organic compounds made for them by the bacteria growing in the tubercles.

That nitrogen circulates throughout the structures of plants in organic combination is certain. There does not appear to be any reason why similar compounds which are soluble and diffusible (amino acids?) should not be taken up through the roots of plants and utilized as such. It appears to the writer that this must very probably be the case. Arguments in favor of this view are:

1. The nitrogen nutrition of the leguminous

plants and others with root-tubercles is of this character.

2. The close symbiosis between "Azotobacter" and similar nitrogen-absorbing bacteria and many species of algæ is well known.

3. The increased production of timothy and other grasses when sown *along with clover,* not merely following, has been demonstrated.

4. The vigorous growth of plants in soils very rich in organic matter. Such material inhibits the growth of the nitrous-nitric bacteria when grown in culture, and may do so in soil, so that nitrates may not account for this vigorous growth.

5. As a general rule the most fertile soils contain the most bacteria.

6. The doctrine that nitrates furnish the nitrogen to plants was established before the activities of bacteria in the soil were suspected and should be re-investigated under conditions absolutely controlled as to sterility. It is probably true in large part, but may not be the exclusive method.

It would seem that one of the chief functions of bacteria in the soil is to prepare soluble organic compounds of nitrogen for the use of green plants. It does not appear to be really necessary that organic nitrogen compounds decomposing in the soil must be "ammonified," "nitrited" and "nitrated," as is now generally held since Winogradsky demonstrated the activities of bacteria in these lines to account for the presence of nitrates in the soil.

Experiments have been made by various observers in growing seedling plants of different kinds in water culture with one, or in some cases, several of the amino acids as sources of nitrogen. Most of these experiments have been disappointing. Plant proteins are not so different from animal proteins, nor plant protoplasm (apart from the chlorophyl-containing portions) from animal protoplasm as to lead one to suppose that it could be built up from one or two amino acids any more than animal protoplasm can. The writer is strongly convinced from investigations on this subject for several years that it should be thoroughly investigated. It will require careful experimentation and possibly rather large funds to provide the amounts of amino acids that would probably be needed, but might result in a decided change in current ideas of soil fertility and in the use of nitrogen fertilizers.

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THE PHILADELPHIA MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The sixty-sixth meeting of the American Association for the Advancement of Science and of the affiliated national scientific societies was held in Philadelphia, December 28, 1914, to January 2, 1915. Houston Hall at the University of Pennsylvania was the headquarters and most of the meetings of the sections and affiliated societies were held in the various buildings of the university.

The registered number of members in attendance was one of the largest in the history of the association, being 1,086. The number for the affiliated societies could not be definitely ascertained. A number of institutions sent delegates to the meeting and ten foreign associates were elected for the meeting. The following affiliated societies met during the week:

American Physical Society.
The Geological Society of America.
Paleontological Society of America.
American Alpine Club.
American Society of Zoologists.
American Society of Naturalists.
American Association of Entomologists.
Entomological Society of America.
Botanical Society of America.
American Phytopathological Society.
Society for Horticultural Science.
Sullivant Moss Society.
American Microscopical Society.
American Fern Society.
American Anthropological Association.
American Folk-Lore Society.
American Psychological Association.
Southern Society for Philosophy and Psychology.
Society of American Bacteriologists.
American Federation of Teachers of the Mathematical and the Natural Sciences.

American Nature Study Society.
School Garden Association of America.
Society of Sigma Xi.

The formal opening of the association took place on Monday evening at the first general session when the meeting was called to order by the retiring president, Dr. Edmund B. Wilson. Dr. Wilson introduced the president of the meeting, Dr. Charles W. Eliot. After the welcoming address and the reply by the president, the retiring president delivered the annual address, on "Some Aspects of Progress of Modern Zoology." This meeting was followed by a reception to the members of the association and affiliated societies by Provost and Mrs. Smith in the university museum.

Two public lectures complimentary to the citizens of Philadelphia and vicinity were given during the week. The first was by Dr. Dayton C. Miller on "The Science of Musical Sounds," on Tuesday evening in the Asbury M. E. Church; the second lecture was by Dr. William H. Nichols on "The War and the Chemical Industry," on Wednesday at the same place. Both of these lectures were well attended.

The sections and affiliated societies held their meetings morning and afternoon during the week and many important papers were read.

Numerous smokers and dinners were held by the various societies. The University of Pennsylvania very generously furnished luncheon each day in the gymnasium for all of those in attendance.

The vice-presidential addresses given before the sections were as follows:

Section A: "The Object of Astronomical and Mathematical Research," by Frank Schlesinger.

Section B: "Recent Evidence for the Existence of the Nucleus Atom," by A. D. Cole.

Section C: "Theories of Fermentation," by C. L. Alsburg.

Section D: "Safety Engineering," by O. P. Hood.

Section E: "The Relief of our Pacific Coast," by J. S. Diller.

Section F: "The Research Work of the Tortugas Laboratory of the Carnegie Institution of Washington," by Alfred G. Mayer.

Section G: "The Economic Trend of Botany," by Henry C. Cowles.

Section H: "The Function and Test of Definition in Psychology," by Walter B. Pillsbury.

Section I: "The Social and Economic Value of Technological Museums," by Judson G. Wall.

Section K: "The Classification of Nervous Reactions," by Theodore Hough.

Section L: "The American Rural Schools," by P. P. Claxton.

Section M: "The Place of Research and of Publicity in the Forthcoming Country-Life Development," by L. H. Bailey.

The most important actions of the council were as follows:

The election of 256 members and 620 fellows.

The committee on policy recommended the following resolutions, which were adopted by the council.

Resolved, That the Committee on Policy shall consist of the president, the permanent secretary and nine other members, three to be elected annually. Non-attendance at the meetings for one year to constitute resignation from the committee.

Second. The following committee was elected; to serve for one year: Messrs. A. A. Noyes, R. S. Woodward and J. McKeen Cattell; to serve for two years, Messrs. D. T. McDougal, W. J. Humphreys and E. L. Nichols; to serve for three years, Messrs. H. L. Fairchild and E. C. Pickering.

Third. Dr. Stewart Paton was elected to fill the vacancy on the committee caused by the death of Dr. C. S. Minot.

Fourth. Dr. Edward S. Morse and Dr. T. C. Mendenhall were made life members of the association under the terms of the Jane M. Smith Fund.

Fifth. Herbert A. Gill was appointed as official auditor for the association.

Sixth. That all committees of the association which have not reported for two years be discontinued.

Seventh. The nomination by the sectional committee of Section I of Mr. Elmer E. Rittenhouse as a fellow and vice-president of that section was approved.

Eighth. The nomination by the sectional committee of Section D of Dr. Frederick W. Taylor as vice-president of that section was approved.

Ninth. There was voted an appropriation of

$1,800 for the salary and expenses of the associate secretary for the Pacific Coast Division for the coming year and $400 for use in an effort to increase the membership and any sum received from entrance fees in excess of $400 to be devoted to the same purpose.

Professor Pickering gave a résumé of the work of the committee on expert evidence and a report of progress on the work of the committee of one hundred on scientific research.

The following names were added to the Pacific Coast Committee:

Professor Henry Landes, University of Washington; President Enoch A. Bryan, State College of Washington; President M. A. Brannon, University of Idaho; Professor Maxwell Adams, University of Nevada; Professor Joseph F. Merrill, director of the School of Mines, University of Utah.

The following resolution from Section K was referred to the committee on policy:

Resolved, That this association establish a standing committee of five members to be known as the "Committee on the Protection of Scientific Research," that this committee from time to time prepare and publish in the name of the association such statements and resolutions as it may consider necessary in the education of the public concerning the value of animal experimentation in the advancing of the medical and biological sciences.

The two following resolutions were adopted.

Resolved, That there be authorized a finance committee of three of which the treasurer shall be a member and chairman.

Resolved, That a committee of seven be appointed on the administration of the income of the research funds of the association, the committee to be the five chairmen of the subcommittees already formed by the committee of one hundred on scientific research, namely, Messrs. E. C. Pickering, C. R. Cross, E. W. Brown, T. W. Richards and E. L. Nichols, and in addition Messrs. E. G. Conklin and R. A. Harper.

Messrs. H. C. Cowles, Henry B. Ward and Dr. Stewart Paton were elected members of the council for three years.

A minute in memory of Charles Sedgwick Minot presented by Mr. J. McKeen Cattell was adopted by a rising vote.

The council at its final meeting passed resolutions extending thanks to Provost Smith, of the University of Pennsylvania, and to all the organizations and institutions who did so much for the comfort and entertainment of the members of the association.

At the meeting of the general committee, the following officers were elected:

President: W. W. Campbell, University of California.

Vice-presidents:

Section A: A. O. Leuschner, University of California.

Section B: Frederick Slate, University of California.

Section C: W. McPherson, Ohio State University.

Section D: Bion J. Arnold, Chicago.

Section E: C. S. Prosser, Ohio State University.

Section F: V. L. Kellogg, Stanford University.

Section G: W. A. Setchell, University of California.

Section H: G. M. Stratton, University of California.

Section I: Geo. F. Kunz, New York.

Section K: F. P. Gay, University of California.

Section L: E. P. Cubberley, Stanford University.

Section M: Eugene Davenport, University of Illinois.

General Secretary: Henry Skinner, Philadelphia.

Secretary of Council: W. E. Henderson, Ohio State University.

C.-E. A. Winslow was elected secretary of Section K, to fill an unexpired term of two years.

Dr. L. O. Howard was again reelected permanent secretary for a term of five years.

The committee voted to hold the summer meeting at San Francisco, August 2 to 7, and the next winter meeting at Columbus, Ohio, from December 27, 1915, to January 1, 1916. A convocation week meeting in which all scientific societies are invited to join is recommended for New York City in 1916–17, and a meeting in 1917–18 to be held in Toronto or Pittsburgh.

E. L. Worsham,
General Secretary